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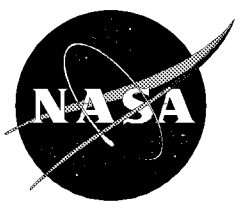
March 2000

AERONAUTICAL ENGINEERING

A CONTINUING BIBLIOGRAPHY WITH INDEXES



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Typical Report Citation and Abstract

❶ 19970001126 NASA Langley Research Center, Hampton, VA USA
❷ **Water Tunnel Flow Visualization Study Through Poststall of 12 Novel Planform Shapes**
❸ Gatlin, Gregory M., NASA Langley Research Center, USA Neuhart, Dan H., Lockheed Engineering and Sciences Co., USA;
❹ Mar. 1996; 130p; In English
❺ Contract(s)/Grant(s): RTOP 505-68-70-04
❻ Report No(s): NASA-TM-4663; NAS 1.15:4663; L-17418; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche
❼ To determine the flow field characteristics of 12 planform geometries, a flow visualization investigation was conducted in the Langley 16- by 24-Inch Water Tunnel. Concepts studied included flat plate representations of diamond wings, twin bodies, double wings, cutout wing configurations, and serrated forebodies. The off-surface flow patterns were identified by injecting colored dyes from the model surface into the free-stream flow. These dyes generally were injected so that the localized vortical flow patterns were visualized. Photographs were obtained for angles of attack ranging from 10' to 50', and all investigations were conducted at a test section speed of 0.25 ft per sec. Results from the investigation indicate that the formation of strong vortices on highly swept forebodies can improve poststall lift characteristics; however, the asymmetric bursting of these vortices could produce substantial control problems. A wing cutout was found to significantly alter the position of the forebody vortex on the wing by shifting the vortex inboard. Serrated forebodies were found to effectively generate multiple vortices over the configuration. Vortices from 65' swept forebody serrations tended to roll together, while vortices from 40' swept serrations were more effective in generating additional lift caused by their more independent nature.
❽ Author
❾ *Water Tunnel Tests; Flow Visualization; Flow Distribution; Free Flow; Planforms; Wing Profiles; Aerodynamic Configurations*

Key

1. Document ID Number; Corporate Source
2. Title
3. Author(s) and Affiliation(s)
4. Publication Date
5. Contract/Grant Number(s)
6. Report Number(s); Availability and Price Codes
7. Abstract
8. Abstract Author
9. Subject Terms

AERONAUTICAL ENGINEERING

A Continuing Bibliography (Suppl. 413)

MARCH 2000

01
AERONAUTICS (GENERAL)

Includes general research topics related to manned and unmanned aircraft and the problems of flight within the Earth's atmosphere. Also includes manufacturing, maintenance, and repair of aircraft.

20000020785 Naval Postgraduate School, Monterey, CA USA
Safety Climate Assessment in Naval Reserve Aviation Maintenance Operations
Oneto, Todd J.; Sep. 1999; 104p; In English
Report No.(s): AD-A370934; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

Naval Aviation's annual Class 'A' Flight Mishap rate is commonly used as a measure of safety effectiveness. Interventions implemented over the past four decades greatly reduced mishap occurence by focusing on aircrew and supervisory error. Less attention has been paid to the role maintenance plays in Naval Aviation mishaps, though it is consistently responsible for approximately 16 percent of all Class 'A' Flight Mishaps. In 1998, a Maintenance Climate Assessment Survey (MCAS) was developed to evaluate safety concerns from the perspective of an aircraft maintainer. This thesis utilized the revised MCAS to assess its validity and utility as a diagnostic tool to access several aircraft communities within the Naval Reserve. It proved useful in aiding Commanders and Aviation Safety Officers (ASOs) in evaluating their maintenance operation's safety posture. The results of this study produced a finalized MCAS for fleet wide distribution. The findings will serve to encourage proactiveness within aviation maintenance in the areas of safety awareness and risk management. This tool will also aid in the monitoring of ongoing safety programs or implementation of new ones.
DTIC
Navy; Aircraft Maintenance; Human Factors Engineering; Aircraft Safety; Military Aviation; Climate

20000020970 NASA Langley Research Center, Hampton,VA USA
Aeronautical Engineering: A Continuing Bibliography with Indexes
November 1999; 106p; In English
Report No.(s): NASA/SP-1999-7037/SUPPL409; NAS 1.21:7037/SUPPL409; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

This supplemental issue of Aeronautical Engineering, A Continuing Bibliography with Indexes (NASA/SP-1999-7037) lists reports, articles, and other documents recently announced in the NASA STI Database. The coverage includes documents on the engineering and theoretical aspects of design, construction, evaluation, testing, operation, and performance of aircraft (including aircraft engines) and associated components, equipment, and systems. It also includes research and development in aerodynamics, aeronautics, and ground support equipment for aeronautical vehicles. Each entry in the publication consists of a standard bibliographic citation accompanied, in most cases, by an abstract. The NASA CASI price code table, addresses of organizations, and document availability information are included before the abstract section. Two indexes-subject and author are included after the abstract section.
Author
Aeronautical Engineering; Bibliographies; Aerodynamics; Indexes (Documentation)

20000021221 NASA Glenn Research Center, Cleveland, OH USA
Unsteady Cascade Aerodynamic Response Using a Multiphysics Simulation Code
Lawrence, C., NASA Glenn Research Center, USA; Reddy, T. S. R., Toledo Univ., USA; Spyropoulos, E., ANSYS, Inc., USA; January 2000; 20p; In English
Contract(s)/Grant(s): RTOP 509-10-11

Report No.(s): NASA/TM-2000-209635; NAS 1.15:209635; E-11964; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The multiphysics code Spectrum(TM) is applied to calculate the unsteady aerodynamic pressures of oscillating cascade of airfoils representing a blade row of a turbomachinery component. Multiphysics simulation is based on a single computational framework for the modeling of multiple interacting physical phenomena, in the present case being between fluids and structures. Interaction constraints are enforced in a fully coupled manner using the augmented-Lagrangian method. The arbitrary Lagrangian-Eulerian method is utilized to account for deformable fluid domains resulting from blade motions. Unsteady pressures are calculated for a cascade designated as the tenth standard, and undergoing plunging and pitching oscillations. The predicted unsteady pressures are compared with those obtained from an unsteady Euler co-de refer-red in the literature. The Spectrum(TM) code predictions showed good correlation for the cases considered.

Author

Unsteady Aerodynamics; Computer Programs; Aerodynamic Characteristics; Airfoils; Computerized Simulation

20000021481 NASA Langley Research Center, Hampton, VA USA

Aeronautical Engineering: A Continuing Bibliography with Indexes, Supplement 408

October 1999; 86p; In English

Report No.(s): NASA/SP-1999-7037/SUPPL408; NAS 1.21:7038/SUPPL408; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

This supplemental issue of Aeronautical Engineering, a Continuing Bibliography with Indexes (NASA/SP#1999-7037) lists reports, articles, and other documents recently announced in the NASA STI Database. The coverage includes documents on the engineering and theoretical aspects of design, construction, evaluation, testing, operation, and performance of aircraft (including aircraft engines) and associated components, equipment, and systems. It also includes research and development in aerodynamics, aeronautics, and ground support equipment for aeronautical vehicles. Each entry in the publication consists of a standard bibliographic citation accompanied, in most cases, by an abstract. The NASA CASI price code table, addresses of organizations, and document availability information are included before the abstract section. Two indexes#subject and author are included after the abstract section.

NASA

Aeronautical Engineering; Bibliographies; Aerodynamics; Indexes (Documentation)

20000024798 NASA, Washington, DC USA

Aeronautics. An Educator's Guide with Activities in Science, Mathematics, and Technology Education: What Pilot, Astronaut, or Aeronautical Engineer didn't Start out with a Toy Glider?

Biggs, Pat, Editor, NASA, USA; Huetter, Ted, Editor, NASA, USA; September 1998; 128p; In English

Report No.(s): NASA/EG-1998-09-105-HQ; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

Welcome to the exciting world of aeronautics. The term aeronautics originated in France, and was derived from the Greek words for "air" and "to sail." It is the study of flight and the operation of aircraft. This educator guide explains basic aeronautical concepts, provides a background in the history of aviation, and sets them within the context of the flight environment (atmosphere, airports, and navigation). The activities in this guide are designed to be uncomplicated and fun. They have been developed by NASA Aerospace Education Services Program specialists, who have successfully used them in countless workshops and student programs around the USA. The activities encourage students to explore the nature of flight, and experience some real-life applications of mathematics, science, and technology. The subject of flight has a wonderful power to inspire learning.

Derived from text

Textbooks; Manuals

20000024885 NASA Langley Research Center, Hampton, VA USA

Aeronautical Engineering: A Continuing Bibliography, Supplement 405

July 1999; 112p; In English

Report No.(s): NASA/SP-1999-7037/Suppl405; NAS 1.21:7037/Suppl405; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

This report lists reports, articles and other documents recently announced in the NASA STI Database. The coverage includes documents on the engineering and theoretical aspects of design, construction, evaluation, testing, operation, and performance of

aircraft (including aircraft engines) and associated components, equipment, and systems. It also includes research and development in aerodynamics, aeronautics, and ground support equipment for aeronautical vehicles.
Derived from text
Data Bases; Bibliographies; Aeronautical Engineering

20000024886 NASA Langley Research Center, Hampton, VA USA
Aeronautical Engineering: A Continuing Bibliography With Indexes, Supplement 407
September 1999; 82p; In English
Report No.(s): NASA/SP-1999-7037/SUPPL407; NAS 1.21:7037/SUPPL407; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

This supplemental issue of Aeronautical Engineering, A Continuing Bibliography with Indexes (NASA/SP-1999-7037) lists reports, articles, and other documents recently announced in the NASA STI Database. The coverage includes documents on the engineering and theoretical aspects of design, construction, evaluation, testing, operation, and performance of aircraft (including aircraft engines) and associated components, equipment, and systems. It also includes research and development in aerodynamics, aeronautics, and ground support equipment for aeronautical vehicles. Each entry in the publication consists of a standard bibliographic citation accompanied, in most cases, by an abstract. The NASA CASI price code table, addresses of organizations, and document availability information are included before the abstract section. Two indexes-subject and author are included after the abstract section.
Author
Aeronautical Engineering; Bibliographies; Aerodynamics; Indexes (Documentation)

20000024887 NASA Langley Research Center, Hampton, VA USA
Aeronautical Engineering: A Continuing Bibliography with Indexes, Supplement 410, Supplement 410
December 1999; 110p; In English
Report No.(s): NASA/SP-1999-7037/SUPPL410; NAS 1.21:7037/SUPPL410; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

This supplemental issue of Aeronautical Engineering, A Continuing Bibliography with Indexes (NASA/SP-1999-7037) lists reports, articles, and other documents recently announced in the NASA STI Database. The coverage includes documents on the engineering and theoretical aspects of design, construction, evaluation, testing, operation, and performance of aircraft (including aircraft engines) and associated components, equipment, and systems. It also includes research and development in aerodynamics, aeronautics, and ground support equipment for aeronautical vehicles. Each entry in the publication consists of a standard bibliographic citation accompanied, in most cases, by an abstract.
Derived from text
Aeronautical Engineering; Bibliographies; Indexes (Documentation); Data Bases

20000025460 NCI Information Systems, Inc., Hanover, MD USA
Building on the Shoulders of Giants: Volume 1
March 2000; In English; 6 CD-ROMs; System requirements: Windows 95/98/NT; minimum 64 MB; installation on hard drive requires 3 GB
Contract(s)/Grant(s): NAS1-96010; No Copyright; Avail: CASI; E05, CD-ROM; The database may be accessed locally from the 6 CD-ROM set, or a 5-user license agreement is available from CASI for LAN access.

Many of the achievements in aerospace science and engineering are based on discoveries made during the years just before, during, and somewhat after the two world wars. From the early discoveries in aerodynamics to the first moments of the space race incited by the Russian satellite Sputnik, the National Advisory Council on Aeronautics (NACA), NASA's forebear, shepherded the advancement of critical technologies in airplane and rocket design. Now anyone can relive those groundbreaking days, and learn from the people who launched mankind into powered flight. Rare photographs, video clips from documentary footage, and practical documents, some of which have never been widely available, let the users pilot their way into a dynamic sphere of human experience, adventure, and aviation achievement. The database leads to selected full text documents, citations, and multimedia clips all with the ease and versatility of the Alchemy search engine. This product will appeal to the aviation enthusiast, engineering student, and aviation engineer--anyone who wants the advantage of a wide range of information topics, such as performance and testing, mechanical engineering, and aircraft design, all on a handy, locally controlled CD-ROM. Whether the goal is building

a model, checking the specifications on a drawing, reliving old glory, or looking for inspiration for an innovation, Building on the Shoulders of Giants makes discovering the value of NACA's science and engineering advancements easier than ever.
CASI
Data Bases; NASA Programs; Aeronautical Engineering; Aerospace Sciences; Aircraft Design

20000025583 NASA Glenn Research Center, Cleveland, OH USA
LWC and Temperature Effects on Ice Accretion Formation on Swept Wings at Glaze Ice Conditions
Vargas, Mario, NASA Glenn Research Center, USA; Reshotko, Eli, Case Western Reserve Univ., USA; January 2000; 40p; In English; 38th; 38th Aerospace Sciences Meeting, 10-13 Jan. 2000, Reno, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA; Original contains color illustrations
Contract(s)/Grant(s): RTOP 548-20-23
Report No.(s): NASA/TM-2000-209777; NAS 1.15:209777; AIAA Paper 2000-0483; E-12059; Copyright Waived; Avail: CASI; A03, Hardcopy; A01, Microfiche

An experiment was conducted to study the effect of liquid water content and temperature on the critical distance in ice accretion formation on swept wings at glaze ice conditions. The critical distance is defined as the distance from the attachment line to tile beginning of the zone where roughness elements develop into glaze ice feathers. A baseline case of 150 mph, 25 F, 0.75 g/cu m. Cloud Liquid Water Content (LWC) and 20 micrometers in Water Droplet Median Volume Diameter (MVD) was chosen. Icing runs were performed on a NACA 0012 swept wing tip at 150 mph and MVD of 20 micrometers for liquid water contents of 0.5 g/cu m, 0.75 g/cu m, and 1.0 g/cu m, and for total temperatures of 20 F, 25 F and 30 F. At each tunnel condition, the sweep angle was changed from 0 deg to 45 deg in 5 deg increments. Casting data, ice shape tracings, and close-up photographic data were obtained. The results showed that decreasing the LWC to 0.5 g/cu m decreases the value of the critical distance at a given sweep angle compared to the baseline case, and starts the formation of complete scallops at 30 sweep angle. Increasing the LWC to 1.0 g/cu m increases the value of the critical distance compared to the baseline case, the critical distance remains always above 0 millimeters and complete scallops are not formed. Decreasing the total temperature to 20 F decreases the critical distance with respect to the baseline case and formation of complete scallops begins at 25 deg sweep angle. When the total temperature is increased to 30 F, bumps covered with roughness elements appear on the ice accretion at 25 deg and 30 deg sweep angles, large ice structures appear at 35 deg and 40 deg sweep angles, and complete scallops are formed at 45 deg sweep angle.
Author
Ice Formation; Temperature Effects; Swept Wings; Glazes; Moisture Content; Deposition

20000025775 National Aerospace Lab., Tokyo Japan
Measurements of Unsteady Pressure Distributions and Dynamic Deformations on an SST Elastic Arrow-Wing Model
Tamayama, M.; Saitoh, K.; Matsushita, H.; Hashidate, M.; Nakamichi, J.; Jun. 1999; 18p; In Japanese; Portions of this document are not fully legible
Report No.(s): PB2000-102569; NAL-TR-1387T; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Unsteady pressure distributions were measured in a series of experiments in the transonic regime for a double-swept-back semi-span SST arrow wing model. The wing is an elastic model, the first natural frequency is 9.79 Hz. Forty-six unsteady pressure transducers and 45 pressure orifices were embedded at two semi-span stations to measure unsteady and steady pressure distributions respectively. The influence of temperature drifts in the wind tunnel could be effectively removed from the pressure transducer signal by timely taking of zero-balance. As a result, the gain of amplifiers was able to be raised, and then high S/N ratio achieved. Dynamic deformation data of the wing model were also measured, using optical targets and CCD cameras. The flow field around the model was excited by a trailing edge flap which was oscillated around a mean deflection angle in the frequency range up to 30 Hz. The model vibration mode changed at the flap frequency near the model 1st resonance. The unsteady pressure distributions were affected by this change of vibration mode. Unsteady lift and moment coefficients were derived from unsteady pressure distributions. Of particular interest is the fact that while the unsteady aerodynamic coefficients were affected strongly by the flap motion at the inboard wing section, they were influenced by the wing vibration at the outboard wing section.
NTIS
Arrow Wings; Aeroelastic Research Wings; Deformation; Pressure Distribution; Pressure Gradients; Unsteady Aerodynamics; Unsteady Flow; Supersonic Transports

02
AERODYNAMICS

Includes aerodynamics of flight vehicles, test bodies, airframe components and combinations, wings, and control surfaces. Also includes aerodynamics of rotors, stators, fans and other elements of turbomachinery.

20000020876 NASA Langley Research Center, Hampton, VA USA
1999 NASA High-Speed Research Performance Workshop, Volume 1, Configuration Aerodynamics
Hahne, David E., Editor, NASA Langley Research Center, USA; 1999 NASA High-Speed Research Performance Workshop; December 1999; 792p; In English; 1999 NASA High-Speed Research Program Aerodynamic Performance Workshop, 8-12 Feb. 1999, Anaheim, CA, USA; See also 20000020877 through 20000020887
Contract(s)/Grant(s): RTOP 537-07-51-10
Report No.(s): NASA/CP-1999-209704/VOL1/PT2; L-17911B; NAS 1.55:209704/VOL1/PT2; No Copyright; Avail: CASI; A99, Hardcopy; A10, Microfiche

NASA's High-Speed Research Program sponsored the 1999 Aerodynamic Performance Technical Review on February 8-12, 1999 in Anaheim, California. The review was designed to bring together NASA and industry High-Speed Civil Transport (HSCT) Aerodynamic Performance technology development participants in the areas of Configuration Aerodynamics (transonic and supersonic cruise drag prediction and minimization), High Lift, and Flight Controls. The review objectives were to (1) report the progress and status of HSCT aerodynamic performance technology development; (2) disseminate this technology within the appropriate technical communities; and (3) promote synergy among the scientists and engineers working on HSCT aerodynamics. In particular, single and midpoint optimized HSCT configurations, HSCT high-lift system performance predictions, and HSCT simulation results were presented, along with executive summaries for all the Aerodynamic Performance technology areas. The HSR Aerodynamic Performance Technical Review was held simultaneously with the annual review of the following airframe technology areas: Materials and Structures, Environmental Impact, Flight Deck, and Technology Integration. Thus, a fourth objective of the Review was to promote synergy between the Aerodynamic Performance technology area and the other technology areas of the HSR Program. This Volume 1/Part 2 publication covers the design optimization and testing sessions.
Author
Aerodynamic Configurations; Computational Fluid Dynamics; Supersonic Transports; Wind Tunnel Tests; Optimization; Aircraft Design

20000020877 Boeing Commercial Airplane Co., Seattle, WA USA
Progress Toward Single and Multi-Point Optimization Tool Realization
Conner, R. S., Boeing Commercial Airplane Co., USA; 1999 NASA High-Speed Research Performance Workshop; December 1999; Volume 1, Part 2, pp. 901-994; In English; See also 20000020876; No Copyright; Avail: CASI; A05, Hardcopy; A10, Microfiche

This presentation covers the progress made during the last year on single and multi-point optimization at BCAG. The highest level goal guiding this work is to accomplish an evaluation of the benefits of nonlinear multi-point optimization. This is not seen as a final answer to the question, but rather just the start. There are many variations on the application of multi-point techniques to the HSCT design problem. The efforts represented here are aimed at the completion of the basic problem that has evolved from many years of linear design efforts. More details of the target evaluation are given in the conclusion of the presentation. Point design technology is not fully mature. As the enabling technology upon which multi-point is built, improved point design is the next highest goal of this work.
Derived from text
Design Analysis; Aircraft Design; Optimization; Aerodynamic Characteristics

20000020878 Boeing Co., Long Beach, CA USA
Design Cycle-Time Reduction Using TLNS3D-Adjoint
Kuruvila, Geojoe, Boeing Co., USA; Narducci, Robert P., Boeing Co., USA; 1999 NASA High-Speed Research Performance Workshop; December 1999; Volume 1, Part 2, pp. 995-1048; In English; See also 20000020876; No Copyright; Avail: CASI; A04, Hardcopy; A10, Microfiche

Significant cycle-time reduction has been achieved by using the TLNS3D-Adjoint code for the aerodynamic shape optimization of High Speed Civil Transport (HSCT) configurations. Using the adjoint of TLNS3D (Euler) flow analysis code, aerodynamic gradients are computed, both accurately and efficiently, for hundreds of design variables. Results obtained by using

TLNS3D-Adjoint in the aerodynamic shape optimization of HSCT Technology Concept Airplane (TCA) configurations are presented.
Derived from text
Aircraft Design; Aircraft Configurations; Design Analysis; Applications Programs (Computers); Optimization

20000020879 Boeing Co., Long Beach, CA USA
Progress Towards Viscous Design Optimization Using Automatic Differentiation
Sundaram, P., Boeing Co., USA; Agrawal, Shreekant, Boeing Co., USA; 1999 NASA High-Speed Research Performance Workshop; December 1999; Volume 1, Part 2, pp. 1049-1110; In English; See also 20000020876; No Copyright; Avail: CASI; A04, Hardcopy; A10, Microfiche

Background Design cycle time in a nonlinear shape optimization process is mainly dependent on the time taken for the objective function sensitivity calculation. Considerable effort has been spent in the past few years to develop efficient techniques for calculating the sensitivities. Primary among them is the method of deriving the adjoints by posing the original continuous form of the problem as a calculus of variation problem. This requires long and tedious analytical derivations and hand-differentiation of the underlying partial differential equations. The adjoint variables for the Euler equations already derived and codes based on this are available. For Navier-Stokes equations, the theory of adjoints is much more complicated and becomes almost intractable. More so, for different turbulence models the hand-differentiation method of adjoints is impractical. The ADIFOR-based methods, on the other hand, are straight-forward and are applied directly to the differential form of the equations of motion already available in the form of FORTRAN codes. The resulting computer-generated differentiated form of the existing function computer codes provide accurate analytical sensitivities. Also, the ADIFOR and ADJIFOR application procedures are the same for both the Euler and Navier-Stokes codes. Thus, it can be seen that the automated procedure for generating adjoint codes using ADJIFOR has several advantages over the hand-differentiated adjoint codes.
Derived from text
Adjoints; Optimization; Differentiators; Applications Programs (Computers); Aircraft Design; FORTRAN

20000020880 Boeing Co., Long Beach, CA USA
Technology Development for a Multipoint Optimization Process for an HSCT
Narducci, Robert, Boeing Co., USA; Hager, James, Boeing Co., USA; Unger, Eric, Boeing Co., USA; Kuruvila, Geojoe, Boeing Co., USA; Sundaram, P., Boeing Co., USA; Hartwich, Peter, Boeing Co., USA; Martin, Grant, Boeing Co., USA; Mendoza, Raul, Boeing Co., USA; Arslan, Alan, Boeing Co., USA; Agrawal, Shreekant, Boeing Co., USA; 1999 NASA High-Speed Research Performance Workshop; December 1999; Volume 1, Part 2, pp. 1111-1162; In English; See also 20000020876; No Copyright; Avail: CASI; A04, Hardcopy; A10, Microfiche

Previous non-linear aerodynamic optimization work has focused mainly on the most important leg of the HSCT mission, the supersonic cruise. The benefits of this single-point optimization has not yet been fully realized and it is possible that with further work the goals of the HSR program may be met. However, consideration of the supersonic cruise performance may not be adequate to obtain a truly optimized HSCT since the airplane flies through diverse flowfields to accomplish each leg of its mission. Much of the technology development in 1998 has been to increase the fidelity of the analysis model, increase the number of degrees-of-freedom of the design, and reduce the cost of optimization. While these elements oppose each other, they are critical for a practical and successful multipoint optimization process. This paper begins by assessing the progress of nonlinear aerodynamic shape optimization towards meeting program goals set for the Technology Concept Airplane (TCA). This section establishes that program goals have not been met and that steps towards reaching these goals may be made through a multipoint approach. The next section defines two approaches for multipoint optimization. The first involves a series of single-point optimizations where the OML is defined by supersonic cruise considerations, and flap schedules are determined in subsequent optimizations at off-design Mach numbers. The second approach involves concurrent assessments of the design performance at all critical Mach numbers. The next section documents the optimization technology development in 1998. This includes enhancements to grid generation, configuration modeling, flow analysis, gradient calculations, and design variable definitions. Intermediate results that demonstrate these technologies conclude this paper.
Author
Supersonic Transports; Aircraft Design; Optimization; Aerodynamic Configurations

20000020881 NASA Ames Research Center, Moffett Field, CA USA
Accounting for Laminar Run & Trip Drag in Supersonic Cruise Performance Testing
Goodsell, Aga M., NASA Ames Research Center, USA; Kennelly, Robert A., NASA Ames Research Center, USA; 1999 NASA High-Speed Research Performance Workshop; December 1999; Volume 1, Part 2, pp. 1163-1196; In English; See also

20000020876; No Copyright; Avail: CASI; A03, Hardcopy; A10, Microfiche

An improved laminar run and trip drag correction methodology for supersonic cruise performance testing was derived. This method required more careful analysis of the flow visualization images which revealed delayed transition particularly on the inboard upper surface, even for the largest trip disks. In addition, a new code was developed to estimate the laminar run correction. Once the data were corrected for laminar run, the correct approach to the analysis of the trip drag became evident. Although the data originally appeared confusing, the corrected data are consistent with previous results. Furthermore, the modified approach, which was described in this presentation, extends prior historical work by taking into account the delayed transition caused by the blunt leading edges.

Derived from text

Flow Visualization; Aerodynamic Drag; Boundary Layer Transition; Supersonic Drag; Aircraft Design; Laminar Boundary Layer

20000020882 NASA Ames Research Center, Moffett Field, CA USA

NCV Flow Diagnostic Test Results

Cappuccio, Mina, NASA Ames Research Center, USA; 1999 NASA High-Speed Research Performance Workshop; December 1999; Volume 1, Part 2, pp. 1197-1288; In English; See also 20000020876; No Copyright; Avail: CASI; A05, Hardcopy; A10, Microfiche

There were two objectives for this test. First, was to assess the reasons why there is approximately 1.5 drag counts (cts) discrepancy between measured and computed drag improvement of the Non-linear Cruise Validation (NCV) over the Technology Concept Airplane (TCA) wing body (WB) configurations. The Navier-Stokes (N-S) pre-test predictions from Boeing Commercial Airplane Group (BCAG) show 4.5 drag cts of improvement for NCV over TCA at a lift coefficient (CL) of 0. I at Mach 2.4. The pre-test predictions from Boeing Phantom Works - Long Beach, BPW-LB, show 3.75 drag cts of improvement. BCAG used OVERFLOW and BPW-LB used CFL3D. The first test entry to validate the improvement was held at the NASA Langley Research Center (LARC) UPV;T, test number 1687. The experimental results showed that the drag improvement was only 2.6 cts, not accounting for laminar run and trip drag. This is approximately 1.5 cts less than predicted computationally. In addition to the low Reynolds Number (RN) test, there was a high RN test in the Boeing Supersonic Wind Tunnel (BSWT) of NCV and TCA. BSV@T test 647 showed that the drag improvement of NCV over TCA was also 2.6 cts, but this did account for laminar run and trip drag. Every effort needed to be done to assess if the improvement measured in LaRC UPWT and BSWT was correct. The second objective, once the first objective was met, was to assess the performance increment of NCV over TCA accounting for the associated laminar run and trip drag corrections in LaRC UPWT. We know that the configurations tested have laminar flow on portions of the wing and have trip drag due to the mechanisms used to force the flow to go from laminar to turbulent aft of the transition location.

Derived from text

Body-Wing Configurations; Aircraft Design; Supersonic Flow; Flow Measurement; Aerodynamic Characteristics; Aerodynamic Configurations

20000020883 NASA Langley Research Center, Hampton, VA USA

Aft Body Closure: Predicted Strut Effects at M=2.4

Lamar, John E., NASA Langley Research Center, USA; Garritz, Javier A., Vigyan Research Associates, Inc., USA; 1999 NASA High-Speed Research Performance Workshop; December 1999; Volume 1, Part 2, pp. 1473-1512; In English; See also 20000020876; No Copyright; Avail: CASI; A03, Hardcopy; A10, Microfiche

This paper reports the predicted M = 2.4 strut-interference effects on a closed aftbody with empennage for the TCA baseline model. The strut mounting technique was needed in order to assess the impact of aft-end shaping, i.e. open for a sting or closed to better represent a flight vehicle. However,this technique can potentially lead to unanticipated effects that are measured on the aft body. Therefore, a set of computations were performed in order to examine the closed aft body with and without strut present, at both zero and non-zero angles of sideslip (AOS). The work was divided into a computational task performed by Javier A. Garriz, using an inviscid (Euler) solver, and a monitoring/reporting task done by John E. Lamar. All this work was performed during FY98 at the NASA Langley Research Center.

Author

Afterbodies; Struts; Aircraft Design; Supersonic Transports; Aerodynamic Interference

20000020884 Boeing Co., Long Beach, CA USA

Flowfield Studies for the TCA/NCV Configurations

Mendoza, Raul, Boeing Co., USA; Shieh, Chih Fang, Boeing Co., USA; Sundaram, P., Boeing Co., USA; 1999 NASA

High-Speed Research Performance Workshop; December 1999; Volume 1, Part 2, pp. 1289-1364; In English; See also 20000020876; No Copyright; Avail: CASI; A05, Hardcopy; A10, Microfiche

The Technology Concept Airplane (TCA) was developed using linear design and analysis methods. Ames Research Center (ARC), the Boeing Commercial Airplanes Group (BCAG), and Boeing Phantom Works (BPW) at Long Beach performed non-linear aerodynamic shape optimization to improve the supersonic cruise performance of the TCA. The three participating sites cross-checked the final designs using Euler and Navier-Stokes analyses of the wing/body (W/B) and wing/body/nacelle/diverter (W/B/N/D) configurations. The three optimized designs differed from each other, but all were shown to improve performance. Nevertheless, only the configuration that exhibited the best performance improvement over the TCA was selected for experimental validation and became known as the Non-linear Cruise point Validation (NCV) design. However, wind-tunnel data did not match the predicted performance of the NCV W/B design. Navier-Stokes computations had shown an expected drag benefit for the NCV W/B configuration on the order of 4 to 4.5 counts over the TCA W/B at cruise conditions; but the improvement measured in the wind tunnel was on the order of only 2 to 2.5 counts. Even though the experimental drag reduction for the W/B/N/D configuration was also smaller than expected, the measured drag benefit associated with the addition of nacelles was considered to have matched the CFD predictions within the scatter of the data. Therefore, this paper will concentrate on the W/B configurations.

Derived from text

Flow Distribution; Body-Wing Configurations; Supersonic Transports; Computational Fluid Dynamics; Wing Nacelle Configurations; Optimization; Drag Reduction

20000020885 NASA Langley Research Center, Hampton, VA USA

Supersonic Aftbody Closure Wind-Tunnel Testing, Data Analysis, and Computational Results

Allen, Jerry, NASA Langley Research Center, USA; Martin, Grant, Boeing Co., USA; Kubiatko, Paul, Boeing Co., USA; 1999 NASA High-Speed Research Performance Workshop; December 1999; Volume 1, Part 2, pp. 1365-1472; In English; See also 20000020876; No Copyright; Avail: CASI; A06, Hardcopy; A10, Microfiche

This paper reports on the model, test, and results from the Langley Supersonic Aftbody Closure wind tunnel test. This project is an experimental evaluation of the 1.5% Technology Concept Aircraft (TCA) aftbody closure model (Model 23) in the Langley Unitary Plan Wind Tunnel. The baseline TCA design is the result of a multidisciplinary, multipoint optimization process and was developed using linear design and analysis methods, supplemented with Euler and Navier-Stokes numerical methods. After a thorough design review, it was decided to use an upswept blade attached to the forebody as the mounting system. Structural concerns dictated that a wingtip support system would not be feasible. Only the aftbody part of the model is metric. The metric break was chosen to be at the fuselage station where prior aft-sting supported models had been truncated. Model 23 is thus a modified version of Model 20. The wing strongback, flap parts, and nacelles from Model 20 were used, whereas new aftbodies, a common forebody, and some new tails were fabricated. In summary, significant differences in longitudinal and direction stability and control characteristics between the ABF and ABB aftbody geometries were measured. Correcting the experimental data obtained for the TCA configuration with the flared aftbody to the representative of the baseline TCA closed aftbody will result in a significant reduction in longitudinal stability, a moderate reduction in stabilizer effectiveness and directional stability, and a moderate to significant reduction in rudder effectiveness. These reductions in the stability and control effectiveness levels of the baseline TCA closed aftbody are attributed to the reduction in carry-over area.

Derived from text

Wind Tunnel Tests; Wind Tunnel Models; Afterbodies; Supersonic Transports; Aircraft Stability; Aircraft Control

20000020886 Boeing Co., Long Beach, CA USA

Thrust Drag Bookkeeping and the Calibration of Nacelles for Internal Drag

Adamson, Eric, Boeing Co., USA; 1999 NASA High-Speed Research Performance Workshop; December 1999; Volume 1, Part 2, pp. 1513-1642; In English; See also 20000020876; No Copyright; Avail: CASI; A07, Hardcopy; A10, Microfiche

The task of developing an internal drag calibration process for HSCT nacelles falls under the category of wind tunnel corrections. For the most part, however, it has been funded out of the Propulsion Induced Effects (PIE) Program. This interesting funding arrangement makes sense because a HSCT nacelle calibration process is a critical requirement for any PIE testing. As the HSCT program has evolved, accurate experimental assessments of nacelle integration effects have become more critical, and nacelle internal geometries have become more complex. As a result, it was apparent that the program had outgrown the empirical nacelle internal skin friction corrections of the past. In the case of M=2.4 cruise point experimental evaluation, the cost and accuracy of CFD based corrections may be sufficient to meet the programs internal drag correction needs. For off-design evaluations, the nacelle internal geometry becomes more complex (ramps & plugs), the number of required CFD runs increase, and convergence time and uncertainty increase. All this adds up to a cost for CFD based corrections that is currently unacceptable.

Consequently, the preferred approach taken by most major transport or fighter programs is to calibrate nacelles. Historically, nacelle calibration has been shown to be a reliable, accurate, and cost effective approach to determining nacelle internal forces. Unfortunately, because of several unique features in current HSCT geometries and the thrust-drag bookkeeping system, the program could not adopt "as-is" an existing calibration procedure from one of these programs. This report documents the results of two tests that were run in the Boeing Flight Simulation Chamber (FSC) to develop an HSCT specific calibration process. The report is divided into 6 parts. The first part is a review of thrust-drag accounting systems. The choice of how internal drag can be obtained is determined by the T-D system. The second part reviews the basic principles concerning how and why calibration works. The third and fourth part review results of the first HSCT calibration test. This test went a long way toward validating a HSCT methodology. The fifth and sixth parts review the results of the second calibration test. This test was intended to use some available hardware to refine the handling of Reynolds number effects and to explore the feasibility of calibrating with supersonic duct flow.
Derived from text
Aerodynamic Drag; Nacelles; Calibrating; Supersonic Transports; Ducted Flow; Wind Tunnel Tests

20000020887 MCAT Inst., Moffett Field, CA USA
Geometry-Driven Mesh Deformation
Reuther, James, MCAT Inst., USA; Rimlinger, Mark J., Raytheon, USA; Saunders, David, Raytheon, USA; 1999 NASA High-Speed Research Performance Workshop; December 1999; Volume 1, Part 2, pp. 867-900; In English; See also 20000020876; No Copyright; Avail: CASI; A03, Hardcopy; A10, Microfiche

At each design step during the application of an aerodynamic shape optimization method, it must be possible to obtain a mesh representing the current design changes and the gradients of the cost function. In an adjoint based method, the determination of changes in the cost function require that the variation in the mesh metrics be computed. Since it would be difficult to obtain an explicit relationship between arbitrary surface changes and variations in mesh metrics for complex configurations, these quantities are calculated through finite differences. This requires the mesh to be regenerated a number of times proportional to the number of design variables. The use of hyperbolic or elliptic iterative mesh generation techniques to construct a mesh for a single design variable perturbation becomes computationally prohibitive and may approach the cost of a flow solution. Additionally, no automated method exists for generating multiblock meshes about complex co three-dimensional configurations. Here, these difficulties are overcome through the use of a mesh perturbation technique. In this approach, a high quality mesh appropriate for the flow solver is first generated by any available procedure prior to the start of the design. This initial mesh becomes the basis for all subsequent meshes which are obtained by analytic perturbations. Applications for a mesh perturbation scheme can be found in any area which wishes to take advantage of an existing mesh in order to avoid the laborious and time intensive process of regenerating a grid system. Rapid mesh morphing permits the reuse of existing mesh topologies on similar configurations as well as analysis and design accounting for static aeroelastics.
Derived from text
Computational Grids; Grid Generation (Mathematics); Aerodynamic Configurations; Aircraft Design; Optimization

20000021080 NASA Langley Research Center, Hampton, VA USA
1999 NASA High-Speed Research Program Aerodynamic Performance Workshop, Volume 2, High Lift
Hahne, David E., Editor, NASA Langley Research Center, USA; 1999 NASA High-Speed Research Program Aerodynamic Performance Workshop; December 1999; 488p; In English; 1999 NASA High-Speed Research Program Aerodynamic Performance Workshop, 8-12 Feb. 1999, Anaheim, CA, USA; See also 20000021081 through 20000021088
Contract(s)/Grant(s): RTOP 537-07-51-10
Report No.(s): NASA/CP-1999-209704/VOL2/PT2; L-17911D; NAS 1.55:209704/VOL2/PT2; No Copyright; Avail: CASI; A21, Hardcopy; A04, Microfiche

NASA's High-Speed Research Program sponsored the 1999 Aerodynamic Performance Technical Review on February 8-12, 1999 in Anaheim, California. The review was designed to bring together NASA and industry High-Speed Civil Transport (HSCT) Aerodynamic Performance technology development participants in the areas of Configuration Aerodynamics (transonic and supersonic cruise drag prediction and minimization), High Lift, and Flight Controls. The review objectives were to (1) report the progress and status of HSCT aerodynamic performance technology development; (2) disseminate this technology within the appropriate technical communities; and (3) promote synergy among die scientists and engineers working on HSCT aerodynamics. In particular, single and midpoint optimized HSCT configurations, HSCT high-lift system performance predictions, and HSCT simulation results were presented, along with executive summaries for all the Aerodynamic Performance technology areas. The HSR Aerodynamic Performance Technical Review was held simultaneously with the annual review of the following airframe technology areas: Materials and Structures, Environmental Impact, Flight Deck, and Technology Integration. Thus, a fourth

objective of the Review was to promote synergy between the Aerodynamic Performance technology area and the other technology areas of the HSR Program. This Volume 2/Part 2 publication covers the tools and methods development session.
Author
Supersonic Transports; Computational Fluid Dynamics; Aircraft Design; Wind Tunnel Tests; Aerodynamic Configurations

20000021081 Boeing Co., Long Beach, CA USA
Numerical Analysis of a 5% HSCT TCA Model in the NASA Ames 12-ft Pressure Tunnel
Woan, Chung–Jin, Boeing Co., USA; 1999 NASA High-Speed Research Program Aerodynamic Performance Workshop; December 1999; Volume 2, Part 2, pp. 551-646; In English; See also 20000021080; No Copyright; Avail: CASI; A05, Hardcopy; A04, Microfiche

The presentation of this paper starts with a statement of objectives followed by the definitions of problems, gridding strategy, enhancements of CFL3D/MAGGIE, Baldwin-Lomax/Degani-Schiff turbulence model, and results. A few concluding remarks and recommendations will be made at the end of the presentation. The overall objective of this task is to develop an integrated wind-tunnel/free-air-CFD process to speed up CFD turnaround time in HSCT high-lift configuration development. The specific objective of this paper is to investigate the effects of the NASA/Ames 12-ft wind tunnel wall and model supports on the model aerodynamic characteristics using CFD, to evaluate the CFD results by comparison with experimental data, and to share our experience in obtaining the Navier-Stokes solutions of the wind tunnel flow simulations for the 5% TCA model. MAGGIE has been greatly enhanced in speed and capability for handling complex geometries. NASA/Ames FOMOCO has been coupled (externally) with CFL3D/MAGGIE for force and moment integration for configurations with overlapping surface grids. CFL3D has been enhanced with FORTRAN 90 run-time memory allocation capability, allowing one executable for all the problems and eliminating the need of user's effort to compile and recompile programs for problems of varying memory sizes. This can increases user's productivity in an application environment. Navier-Stokes solutions for the 5% TCA model in the NASA/Ames 12-ft pressure tunnel have been presented and compared with the free-air CFD solution and test data in terms of C(sub P), C(sub L), C(sub D), and C(sub M). Numerical results indicated that based on the CFL3D default implementation of the Baldwin-Lomax/Degani-Schiff model, the turbulence length scale was computed as the distance from the solid wall to the core of the primary vortex, resulting reduced vortex suction peak. Using reduced cutoff of searching distance, the CFD solutions were greatly improved in the regions of both leading and trailing edge flaps. It is numerically difficult to implement the Degani-Schiff modification in the region where off-body vortex flow exists and or flow is separated. In general, the CFD calculated surface pressures, lift and drag coefficients are compared very favorably with the wind-tunnel test data. CFD calculated vortex strength and location agree well with the experiment. However, the CFD calculated attack of attack of the LE vortex flow separation is smaller than that of the experiment. In general, the CFD calculated surface pressures, lift and drag coefficients are compared very favorably with the wind-tunnel test data. The CFD calculated post effects on the lower wing surface pressures agree well with the test data.
Derived from text
Supersonic Transports; Wind Tunnel Tests; Wind Tunnel Models; Applications Programs (Computers); Computational Fluid Dynamics; Baldwin-Lomax Turbulence Model; Aerodynamic Configurations

20000021082 Boeing Co., Long Beach, CA USA
CFD Assessment of TCA High-Lift Configurations
Yeh, David T., Boeing Co., USA; Clark, Roger W., Boeing Co., USA; 1999 NASA High-Speed Research Program Aerodynamic Performance Workshop; December 1999; Volume 2, Part 2, pp. 647-726; In English; See also 20000021080; No Copyright; Avail: CASI; A05, Hardcopy; A04, Microfiche

This report starts with the description of the objective for the HSCT high-lift CFD analysis, and the focus of current study, followed by the numerical approach. Numerical results will be presented on the effects of the wing planforms, inboard LE flap extent and the forebody chine effects at high-lift conditions. For the Wing/Body/Canard configurations, the influence of the canard on the high-lift configuration will be discussed. Code validation will be presented through the direct correlation with available tunnel test data. This report concludes with a summary and a description of the on- going high-lift CFD effort. The objective of the high-lift CFD analysis is to provide the numerical tools for the design and optimization of the high-lift system including wind-tunnel support and the evaluation of the aerodynamic performance as the configuration evolves. to accomplish this objective, it is necessary to develop and enhance the numerical modeling capability for the high-lift devices such as various types of LE & TE flaps and forebody control surfaces. It is also necessary to assess the numerical capability to accurately model the flow phenomena under the high-lift conditions, near design as well as off-design conditions. The numerical solutions are also utilized to provide a better physical understanding of the flow physics. In summary, the numerical modeling capability for the high-lift devices including multiple LE and TE flap surfaces and the forebody control surfaces has been demonstrated. The

numerical results have shown the ability to capture the effects of planforms, inboard LE flaps and canard influence on the high-lift configurations. The pre-test analysis of ground roll inlet ingestion of the canard tip vortex was verified in the TCA-4 wind tunnel test. An alternative high-mount canard has been studied to move the canard vortex above the wing at alpha = 0. Additional study of the numerical issues is needed in the off-design conditions in order to accurately capture the viscous phenomena associated with flow separation, reattachment as well as vortex formation, convection and their interactions with the wing. The numerical results are summarized as follows: Full span LE flaps have been shown to promote attached flow as compared to the part-span LE flaps resulting in a better lift-to-drag ratio and more favorable pitch characteristics. In terms of the flow features for the different planforms, the numerical solutions have shown similar forebody and inboard wing flow patterns for the TCA-4 tested planforms. One of the noticeable distinctions is the appearance of the outboard LE flap vortex on the baseline TCA near the design condition (CL = .5) while attached flow is observed in the outboard region for W2 and W3 wings. The forebody chine is predicted to have little influence on the lift and drag forces, but it creates a slightly higher nose-up pitching moment. The effect of the TCA-4 canard is seen to create a downwash in the inboard region near the wing apex. The upwash influence associated with canard tip vortex appears to be insignificant. As a result, the influence of the planform change on the canard effect is expected to be small due to the local changes on the apex vortex that alters the downstream flow field primarily in the inboard region. The simulated canard tip vortex that enters the inlets at alpha = 0 has been verified experimentally in the TCA-4 test. The TCA-5 high-mount canard tip vortex is predicted to pass above the wing at alpha = 0.

Derived from text

Aerodynamic Characteristics; Canard Configurations; Computational Fluid Dynamics; Flaps (Control Surfaces); Forebodies; Supersonic Transports; Wind Tunnel Tests; Body-Wing Configurations

20000021083 Boeing Commercial Airplane Co., Seattle, WA USA

A Comparison of CFL3D and TLNS CFD Results on TCA and Ref-H High Lift Configurations

Siebersma, Tim, Boeing Commercial Airplane Co., USA; 1999 NASA High-Speed Research Program Aerodynamic Performance Workshop; December 1999; Volume 2, Part 2, pp. 727-802; In English; See also 20000021080; No Copyright; Avail: CASI; A05, Hardcopy; A04, Microfiche

This report begins with a list of the objectives for this study. Next, numerical results are presented for a TCA 2.8-38 high lift configuration. These include CFL3D results with two different grids, as well as comparisons between CFL3D, TLNS and wind tunnel data. Ref-H numerical results are then presented. These include both a flaps up CFL3D comparison with NTF wind tunnel data, and a leading edge flap span effect comparison between CFL3D, TLNS and 14x22 wind tunnel data. The report ends with a list of conclusions and recommendations. This study has shown that with the Boeing Phantom Works gridding tools, even an inexperienced CFD user can now successfully run 3D Navier-Stokes on a high lift HSCT configuration. These gridding tools simplify the creation of the flaps down grid, and significantly reduce the cycle time required for the numerical analysis. Running on several configurations has also created an opportunity to make the tools more general and more robust. This study has also shown that the grid topology on the forebody of an HSCT configuration can affect the flow field over the body. This should not significantly influence the results of wing or flap studies, but may become important when looking at canard, chin fin, or other forebody studies. It remains to be verified which of the two body flow fields seen in these results is more realistic. On the TCA 2.8-38 configuration, the CFD results have shown that CFL3D consistently shows better agreement with the wind tunnel force data than does TLNS. While both codes successfully capture the main flow features, several differences can be seen in the details of the flow field. Various aspects of each code's results are supported by the test data, and further comparison and analysis is warranted. On the Ref-H configuration, CFL3D was shown to have better agreement with the test data in terms of the effect of leading edge flap span on lift and drag at the operating condition. Both CFL3D and 14x22 test data showed a negligible effect for changing the flap span, while TLNS showed a significant increase in drag for the part-span flaps relative to the full-span flaps. At angles of attack significantly higher than that for the operating condition, CFL3D did not converge well, especially with the part-span leading edge. Previous results with TLNS have shown good convergence and good results at these higher angles of attack. This study has also left many questions unanswered and has shown a need for more comparisons between CFD results and test data. The upcoming CFD wind tunnel test in the Ames 7x10 tunnel and the upcoming TCA-5 test in the Ames 12' tunnel should provide a wealth of good data for further study of this kind. The CFD test will be using the Ref-H configuration, while TCA-5 will be using the TCA 2.8-38 configuration. Continued work in this area will pave the way for further optimization of high lift aerodynamic performance.

Derived from text

Aerodynamic Configurations; Computational Fluid Dynamics; Lift; Supersonic Transports; Wind Tunnel Tests; Applications Programs (Computers); Aircraft Configurations

20000021084 ASE Technologies, Inc., Cincinnati, OH USA

Comparison of CFD Solutions with Test Data for TCA High Lift Configurations

Fan, Xuetong, ASE Technologies, Inc., USA; 1999 NASA High-Speed Research Program Aerodynamic Performance Workshop; December 1999; Volume 2, Part 2, pp. 803-856; In English; See also 20000021080; No Copyright; Avail: CASI; A04, Hardcopy; A04, Microfiche

This report documents the comparison between CFL3D solutions and wind tunnel test data for TCA high lift wing/body and wing/body/nacelle configurations. Part 1 compares the lift and drag coefficients between CFL3D and test data with emphasis on the predicted measured lift and drag increments due to nacelles. Part 2 compares the pressure distribution on wing upper and lower surfaces between CFL3D and test data to show the strength and locations of leading edge (LE) vortices. Part 3 compares the change in pressure distribution from wing/body to wing/body/nacelle on wing upper surface. This comparison will reveal the effect of nacelles on the LE vortices.

Derived from text

Computational Fluid Dynamics; Body-Wing Configurations; Aerodynamic Coefficients; Wind Tunnel Tests; Pressure Distribution; Wing Nacelle Configurations

20000021085 Boeing Co., Long Beach, CA USA

Numerical Analysis of Lateral Control Characteristics of HSCT Forebody Control Surfaces

Yeh, David T., Boeing Co., USA; Clark, Roger W., Boeing Co., USA; 1999 NASA High-Speed Research Program Aerodynamic Performance Workshop; December 1999; Volume 2, Part 2, pp. 857-912; In English; See also 20000021080; No Copyright; Avail: CASI; A04, Hardcopy; A04, Microfiche

This report starts with the description of the objective and the focus of current study, followed by the approach. The numerical results will be presented for the chin fin lateral control effectiveness at various angle-of-attack and an alternative control concept using the high-mount canards with asymmetric elevator deflection. The numerical results for the chin fin study will be compared with TCA 4 test results for data correlation. The numerical results for the high-mount canards will be used to define some of the CFD runs in TCA-5 test. In summary, the numerical capability to model forebody control surfaces has been demonstrated for the chin fin and asymmetric canard deflections. Favorable comparisons of the trends for the side force and yawing moment are observed between the numerical prediction and the TCA-4 chin fin test results. The numerical results have shown that the chin fin provides the lateral control at alpha zero, but the effectiveness vanishes at alpha 10 degrees due to the counteracting vortex influence on the side of the forebody. On the other hand, the lateral control is enhanced at alpha= -10, which is equivalent to a top-mount control surface at alpha= 10, due to the favorable vortex interaction in the cross flow. The numerical solutions have also shown that the high-mount canard with asymmetric elevator deflections provides the lateral control effectiveness. Based on the simulated cases, it is observed that the lateral control would be enhanced when one side of the canard/elevator is unloaded. By unloading one side, the potential stalling phenomenon can be avoided which would provide a greater asymmetry in the canard region. The asymmetrical influence by the favorable vortex interaction in cross flow further enhances the lateral control authority.

Author

Lateral Control; Computational Fluid Dynamics; Canard Configurations; Supersonic Transports; Control Surfaces

20000021086 NASA Langley Research Center, Hampton, VA USA

High-Lift CFD Validation

Lessard, Wendy B., NASA Langley Research Center, USA; 1999 NASA High-Speed Research Program Aerodynamic Performance Workshop; December 1999; Volume 2, Part 2, pp. 913-948; In English; See also 20000021080; No Copyright; Avail: CASI; A03, Hardcopy; A04, Microfiche

It is not unusual when comparing CFD data to experimental data to find discrepancies between the results. Sometimes forces and moments compare well, while surface pressures do not, and vice versa. It is commonplace for the researcher to believe that the flow field has been accurately simulated when these types of measurements compare well. However, being able to routinely predict boundary layer transition and separated flows are not guaranteed. In fact accurate simulation of these types of flow physics has been a challenge to the CFD community. In order to improve Navier-Stokes predictions for complex vortical flow fields, more detailed information about the flow physics is necessary. Unfortunately, the many wind-tunnel tests performed in Langley's NTF and 14x22 facilities as well as in the Ames' 12 ft. Tunnel provided little information about the detailed flow physics, and no priority was given to obtaining any CFD measurements. Using the latest experimental techniques, this information can and should be obtained for present and future use.

Derived from text

Computational Fluid Dynamics; Navier-Stokes Equation; Applications Programs (Computers); Boundary Layer Transition; Flow Distribution

20000021087 Boeing Co., Long Beach, CA USA

Panel Method Analysis of Wind Tunnel Model Support Effects in the Langley 14x22-ft and Ames 12-ft Wind Tunnels

Polito, Ryan, Boeing Co., USA; 1999 NASA High-Speed Research Program Aerodynamic Performance Workshop; December 1999; Volume 2, Part 2, pp. 949-992; In English; See also 20000021080; No Copyright; Avail: CASI; A03, Hardcopy; A04, Microfiche

This paper is separated into two sections. Section 1 is a continuation of an earlier paper presented at the 1997 HSR Workshop and centers around LaRC 442 Ref H U&I test conducted in November, 1996. Section 2 is an attempt to apply what was learned from the U&I test to the TCA configuration in the LaRC 14x22-ft and Ames 12-ft tunnels.

Derived from text

Panel Method (Fluid Dynamics); Wind Tunnel Tests; Aerodynamic Configurations; Support Interference

20000021088 Boeing Co., Long Beach, CA USA

Evaluation of the Linear Prediction of the Effects of Planform Variation and Flap Deflection

Clark, Roger, Boeing Co., USA; Polito, Ryan, Boeing Co., USA; 1999 NASA High-Speed Research Program Aerodynamic Performance Workshop; December 1999; Volume 2, Part 2, pp. 993-1030; In English; See also 20000021080; No Copyright; Avail: CASI; A03, Hardcopy; A04, Microfiche

This paper presents a documentation of the capabilities of the linear performance prediction code, Aero2s/Aero3s, which is widely used to provide aerodynamic performance build up required for aircraft sizing studies. The code predictions are evaluated against the database obtained for the TCA 5% high-lift model tested in the Langley 14x22-foot Wind Tunnel in tests TCA 1 (LARC 449) and TCA 4 (LARC 473). These tests provide data for the baseline TCA configuration, as well as for two alternate planform configurations.The conclusions from this study are outlined here. While the code does a reasonable job of predicting the forces for predominantly attached flow, it becomes unreliable as the effects of viscous separation become larger. For the baseline TCA wing, W1, where there is significant flow separation on the outboard wing panel at the nominal design point, Aero2s significantly under-predicts the drag. On the other hand, for the higher aspect ratio wings, W2 and W3, the absolute levels of lift and drag are predicted reasonably well. This means that the performance increments resulting from the change in aspect ratio and outboard wing sweep are not well captured by the code. The use of Navier-Stokes methods can give a much more accurate indication of high-lift performance, but the complexity and computational cost of such methods does not yet permit extensive use in the preliminary design process.

Derived from text

Linear Prediction; Planforms; Aerodynamic Drag; Trailing Edge Flaps; Leading Edge Flaps; Aerodynamic Characteristics; Applications Programs (Computers); Computational Fluid Dynamics

20000021216 NASA Langley Research Center, Hampton, VA USA

Unstructured Grid Euler Method Assessment for Longitudinal and Lateral/Directional Aerodynamic Performance Analysis of the HSR Technology Concept Airplane at Supersonic Cruise Speed

Ghaffari, Farhad, NASA Langley Research Center, USA; December 1999; 44p; In English

Contract(s)/Grant(s): RTOP 537-07-22-24

Report No.(s): NASA/TP-1999-209543; L-17737; NAS 1.60:209543; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Unstructured grid Euler computations, performed at supersonic cruise speed, are presented for a High Speed Civil Transport (HSCT) configuration, designated as the Technology Concept Airplane (TCA) within the High Speed Research (HSR) Program. The numerical results are obtained for the complete TCA cruise configuration which includes the wing, fuselage, empennage, diverters, and flow through nacelles at M (sub infinity) = 2.4 for a range of angles-of-attack and sideslip. Although all the present computations are performed for the complete TCA configuration, appropriate assumptions derived from the fundamental supersonic aerodynamic principles have been made to extract aerodynamic predictions to complement the experimental data obtained from a 1.675%-scaled truncated (aft fuselage/empennage components removed) TCA model. The validity of the computational results, derived from the latter assumptions, are thoroughly addressed and discussed in detail. The computed surface and off-surface flow characteristics are analyzed and the pressure coefficient contours on the wing lower surface are shown to correlate reasonably well with the available pressure sensitive paint results, particularly, for the complex flow structures around the nacelles. The predicted longitudinal and lateral/directional performance characteristics for the truncated TCA configuration are shown to correlate very well with the corresponding wind-tunnel data across the examined range of angles-of-attack and sideslip. The complementary computational results for the longitudinal and lateral/directional performance characteristics for the complete TCA configuration are also presented along with the aerodynamic effects due to empennage components. Results are

also presented to assess the computational method performance, solution sensitivity to grid refinement, and solution convergence characteristics.
Author
Computational Fluid Dynamics; Supersonic Transports; Unstructured Grids (Mathematics); Euler Equations of Motion; Mathematical Models; Aerodynamic Characteristics; Wind Tunnel Tests

20000021219 Vigyan Research Associates, Inc., Hampton, VA USA
Low Speed Analysis of Mission Adaptive Flaps on a High Speed Civil Transport Configuration
Lessard, Victor R., Vigyan Research Associates, Inc., USA; December 1999; 82p; In English
Contract(s)/Grant(s): NAS1-19672; RTOP 537-07-22
Report No.(s): NASA/CR-1999-209524; NAS 1.26:209524; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

Thin-layer Navier-Stokes analyses were done on a high speed civil transport configuration with mission adaptive leading-edge flaps. The flow conditions simulated were Mach = 0.22 and Reynolds number of 4.27 million for angles-of-attack ranging from 0 to 18 degrees. Two turbulence closure models were used. Analyses were done exclusively with the Baldwin-Lomax turbulence model at low angle-of-attack conditions. At high angles-of-attack where considerable flow separation and vortices occurred the Spalart-Allmaras turbulence model was also considered. The effects of flow transition were studied. Predicted aerodynamic forces, moment, and pressure are compared to experimental data obtained in the 14- by 22-Foot Subsonic Tunnel at NASA Langley. The forces and moments correlated well with experimental data in terms of trends. Drag and pitching moment were consistently underpredicted. Predicted surface pressures compared well with experiment at low angles-of-attack. Above 10 angle-of-attack the pressure comparisons were not as favorable. The two turbulent models affected the pressures on the flap considerably and neither produced correct results at the high angles-of-attack.
Author
Thin Films; Low Speed; Flapping; Turbulence Models; Pitching Moments; Mathematical Models; Leading Edge Flaps; Boundary Layer Separation; Baldwin-Lomax Turbulence Model

20000021448 NASA Langley Research Center, Hampton, VA USA
Dynamics of Active Separation Control at High Reynolds Numbers
Pack, LaTunia G., NASA Langley Research Center, USA; Seifert, Avi, National Academy of Sciences - National Research Council, USA; [2000]; 16p; In English; 38th; 38th Aerospace Sciences Meeting, 10-13 Jan. 2000, Reno, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Report No.(s): AIAA Paper 2000-0409; Copyright Waived; Avail: CASI; A03, Hardcopy; A01, Microfiche

A series of active flow control experiments were recently conducted at high Reynolds numbers on a generic separated configuration. The model simulates the upper surface of a 20% thick Glauert-Goldschmied type airfoil at zero angle of attack. The flow is fully turbulent since the tunnel sidewall boundary layer flows over the model. The main motivation for the experiments is to generate a comprehensive data base for validation of unsteady numerical simulation as a first step in the development of a CFD design tool, without which it would not be possible to effectively utilize the great potential of unsteady flow control. This paper focuses on the dynamics of several key features of the baseline as well as the controlled flow. It was found that the thickness of the upstream boundary layer has a negligible effect on the flow dynamics. It is speculated that separation is caused mainly by the highly convex surface while viscous effects are less important. The two-dimensional separated flow contains unsteady waves centered on a reduced frequency of 0.8, while in the three dimensional separated flow, frequencies around a reduced frequency of 0.3 and 1 are active. Several scenarios of resonant wave interaction take place at the separated shear-layer and in the pressure recovery region. The unstable reduced frequency bands for periodic excitation are centered on 1.5 and 5, but these reduced frequencies are based on the length of the baseline bubble that shortens due to the excitation. The conventional swept wing-scaling works well for the coherent wave features. Reproduction of these dynamic effects by a numerical simulation would provide benchmark validation.
Author
Active Control; High Reynolds Number; Computational Fluid Dynamics; Three Dimensional Flow; Two Dimensional Flow; Turbulent Flow

20000021524 NASA Langley Research Center, Hampton, VA USA
A Factorial Data Rate and Dwell Time Experiment in the National Transonic Facility
DeLoach, R., NASA Langley Research Center, USA; [2000]; 16p; In English; 38th; 38th Aerospace Sciences Meeting and Exhibit, 10-13 Jan. 2000, Reno, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Report No.(s): AIAA Paper 2000-0828; Copyright Waived; Avail: CASI; A03, Hardcopy; A01, Microfiche

This report is an introductory tutorial on the application of formal experiment design methods to wind tunnel testing, for the benefit of aeronautical engineers with little formal experiment design training. It also describes the results of a Study to determine whether increases in the sample rate and dwell time of the National Transonic Facility data system Would result in significant changes in force and moment data. Increases in sample rate from 10 samples per second to 50 samples per second were examined, as were changes in dwell time from one second per data point to two seconds. These changes were examined for a representative aircraft model in a range of tunnel operating conditions defined by angles of attack from 0 deg to 3.8 degrees, total pressure from 15.0 psi to 24.1 psi, and Mach numbers from 0.52 to 0.82. No statistically significant effect was associated with the change in sample rate. The change in dwell time from one second to two seconds affected axial force measurements, and to a lesser degree normal force measurements. This dwell effect comprises a "rectification error" caused by incomplete cancellation of the positive and negative elements of certain low frequency dynamic components that are not rejected by the one-Hz low-pass filters of the data system. These low frequency effects may be due to tunnel circuit phenomena and other sources. The magnitude of the dwell effect depends on dynamic pressure, with angle of attack and Mach number influencing the strength of this dependence. An analysis is presented which suggests that the magnitude of the rectification error depends on the ratio of measurement dwell time to the period of the low-frequency dynamics, as well as the amplitude of the dynamics The essential conclusion of this analysis is that extending the dwell time (or, equivalently, replicating short-dwell data points) reduces the rectification error.
Author
Factorials; Data Integration; Dwell; Time Functions; Experimentation; Experiment Design; Dynamic Pressure; Aircraft Models

20000021525 NASA Langley Research Center, Hampton, VA USA
Unsteady Slat-Wake Characteristics of a High-Lift Configuration
Paschal, K., NASA Langley Research Center, USA; Jenkins, Luther, NASA Langley Research Center, USA; Yao, Cungsheng, NASA Langley Research Center, USA; [2000]; 10p; In English; 38th; 38th Aerospace Sciences Meeting and Exhibit, 10-13 Jan. 2000, Reno, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA; Original contains color illustrations
Report No.(s): AIAA Paper 2000-0139; Copyright Waived; Avail: CASI; A02, Hardcopy; A01, Microfiche

Unsteady characteristics of the slat wake associated with a three-element high-lift model were investigated with Particle Image Velocimetry (PIV). The test was conducted in the NASA Langley Basic Aerodynamic Research Tunnel (BART) employing sidewall blowing to maintain 2-D flow over the high-lift configuration. The main goal of the experiment was to document spatial characteristics of the unsteady slat wake in an effort to further guide computational efforts. PIV measurements were made at 4, 8, and 10 degrees angle of attack. Instantaneous vector maps revealed organized structures that had been ejected from the slat cove merging with the slat wake. This phenomenon is attributed to the unsteadiness of the recirculation region in the slat cove. The unsteadiness is most pronounced at 4 degrees. Mean data show a wide, diffuse wake at 4 degrees that becomes both narrow and well defined at 10 degrees angle of attack. Second-order statistics suggest a similar trend. These statistics show higher levels of fluctuations due to slat cove unsteadiness and turbulence at 4 degrees, while the slat cove flow has apparently stabilized at the higher angles of attack.
Author
Wakes; Unsteady State; Turbulence; Two Dimensional Models

20000021526 Institute for Computer Applications in Science and Engineering, Hampton, VA USA
Parallel Unstructured Mesh Analysis of High-Lift Configurations
Mavriplis, D. J., Institute for Computer Applications in Science and Engineering, USA; 2000; 16p; In English; 38th; Aerospace Sciences, 10-13 Jan. 2000, Reno, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Report No.(s): AIAA Paper 2000-0923; Copyright Waived; Avail: CASI; A03, Hardcopy; A01, Microfiche

A Reynolds-averaged Navier-Stokes solver based on unstructured mesh techniques for analysis of high-lift configurations is described. The method makes use of an agglomeration multigrid solver for convergence acceleration. Implicit line-smoothing is employed to relieve the stiffness associated with highly stretched meshes. A GMRES technique is also implemented to speed convergence at the expense of additional memory usage. Tile solver is cache efficient and fully vectorizable, and is parallelized using a two-level hybrid MPI-OpenMP implementation suitable for shared and/or distributed memory architectures, as well as clusters of shared memory machines. Convergence and scalability results are illustrated for various high-lift cases.
Author
Aerodynamic Configurations; Architecture (Computers); Computational Grids; Unstructured Grids (Mathematics); Lift

20000021552 NASA Langley Research Center, Hampton, VA USA

Experimental and Numerical Optimization of a High-Lift System to Improve Low-Speed Performance, Stability, and Control of an Arrow-Wing Supersonic Transport

Hahne, David E., NASA Langley Research Center, USA; Glaab, Louis J., Lockheed Engineering and Sciences Co., USA; December 1999; 86p; In English

Contract(s)/Grant(s): RTOP 537-03-22-08

Report No.(s): NASA/TP-1999-209539; NAS 1.60-209539; L-17537; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

An investigation was performed to evaluate leading-and trailing-edge flap deflections for optimal aerodynamic performance of a High-Speed Civil Transport concept during takeoff and approach-to-landing conditions. The configuration used for this study was designed by the Douglas Aircraft Company during the 1970's. A 0.1-scale model of this configuration was tested in the Langley 30- by 60-Foot Tunnel with both the original leading-edge flap system and a new leading-edge flap system, which was designed with modem computational flow analysis and optimization tools. Leading-and trailing-edge flap deflections were generated for the original and modified leading-edge flap systems with the computational flow analysis and optimization tools. Although wind tunnel data indicated improvements in aerodynamic performance for the analytically derived flap deflections for both leading-edge flap systems, perturbations of the analytically derived leading-edge flap deflections yielded significant additional improvements in aerodynamic performance. In addition to the aerodynamic performance optimization testing, stability and control data were also obtained. An evaluation of the crosswind landing capability of the aircraft configuration revealed that insufficient lateral control existed as a result of high levels of lateral stability. Deflection of the leading-and trailing-edge flaps improved the crosswind landing capability of the vehicle considerably; however, additional improvements are required.

Author

Numerical Analysis; Experimentation; Data Acquisition; Lift Devices; Leading Edge Flaps; Lateral Control; Lateral Stability; Analysis (Mathematics); Performance Tests

20000021556 NASA Langley Research Center, Hampton, VA USA

Sweep and Compressibility Effects on Active Separation Control at High Reynolds Numbers

Seifert, Avi, National Academy of Sciences - National Research Council, USA; Pack, LaTunia G., NASA Langley Research Center, USA; [2000]; 18p; In English; 38th; 38th Aerospace Sciences Meeting and Exhibit, 10-13 Jan. 2000, Reno, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Report No.(s): AIAA Paper 2000-0410; Copyright Waived; Avail: CASI; A03, Hardcopy; A01, Microfiche

This paper explores the effects of compressibility, sweep and excitation location on active separation control at high Reynolds numbers. The model, which was tested in a cryogenic pressurized wind tunnel, simulates the upper surface of a 20% thick Glauert Goldschmied type airfoil at zero angle of attack. The flow is fully turbulent since the tunnel sidewall boundary layer flows over the model. Without control, the flow separates at the highly convex area and a large turbulent separation bubble is formed. Periodic excitation is applied to gradually eliminate the separation bubble. Two alternative blowing slot locations as well as the effect of compressibility, sweep and steady suction or blowing were studied. During the test the Reynolds numbers ranged from 2 to 40 million and Mach numbers ranged from 0.2 to 0.7. Sweep angles were 0 and 30 deg. It was found that excitation must be introduced slightly upstream of the separation region regardless of the sweep angle at low Mach number. Introduction of excitation upstream of the shock wave is more effective than at its foot. Compressibility reduces the ability of steady mass transfer and periodic excitation to control the separation bubble but excitation has an effect on the integral parameters, which is similar to that observed in low Mach numbers. The conventional swept flow scaling is valid for fully and even partially attached flow, but different scaling is required for the separated 3D flow. The effectiveness of the active control is not reduced by sweep. Detailed flow field dynamics are described in the accompanying paper.

Author

Airfoils; Boundary Layer Flow; Excitation; Flow Distribution; High Reynolds Number; Subsonic Speed; Sweep Angle; Turbulence; Compressibility

20000021569 NASA Langley Research Center, Hampton, VA USA

Low-Speed Aerodynamic Data for an 0.18-Scale Model of an F-16XL with Various Leading-Edge Modifications

Hahne, Daniel E., NASA Langley Research Center, USA; December 1999; 170p; In English

Contract(s)/Grant(s): RTOP 537-03-22-08

Report No.(s): NASA/TM-1999-209703; NAS 1.15:209703; L-17921; No Copyright; Avail: CASI; A08, Hardcopy; A02, Microfiche

Using the F-16XL as a test-bed, two strategies for improving the low-speed flying characteristics that had minimal impact on high-speed performance were evaluated. In addition to the basic F-16XL configuration several modifications to the baseline configuration were tested in the Langley 30- X 60-Foot Tunnel: 1) the notched area at the wing leading edge and fuselage juncture was removed resulting in a continuous 70 deg leading-edge sweep on the inboard portion of the wing; 2) an integral attached-flow leading-edge flap concept was added to the continuous leading edge; and 3) a deployable vortex flap concept was added to the continuous leading edge. The purpose of this report is simply to document the test configurations, test conditions, and data obtained in this investigation for future reference and analysis. No analysis is presented herein and the data only appear in tabulated format.

Author

Scale Models; Leading Edges; Data Bases

20000021572 Mississippi State Univ., Mississippi State, MS USA

ICEG2D: An Integrated Software Package for Automated Prediction of Flow Fields for Single-Element Airfoils with Ice Accretion *Final Report*

Thompson, David S., Mississippi State Univ., USA; Soni, Bharat K., Mississippi State Univ., USA; February 2000; 66p; In English

Contract(s)/Grant(s): NAG3-2235; RTOP 548-20-23

Report No.(s): NASA/CR-2000-209914; NAS 1.26:209914; E-12146; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

An integrated software package, ICEG2D, was developed to automate computational fluid dynamics (CFD) simulations for single-element airfoils with ice accretion. ICEG2D is designed to automatically perform three primary functions: (1) generating a grid-ready, surface definition based on the geometrical characteristics of the iced airfoil surface, (2) generating a high-quality grid using the generated surface point distribution, and (3) generating the input and restart files needed to run the general purpose CFD solver NPARC. ICEG2D can be executed in batch mode using a script file or in an interactive mode by entering directives from a command line. This report summarizes activities completed in the first year of a three-year research and development program to address issues related to CFD simulations for aircraft components with ice accretion. Specifically, this document describes the technology employed in the software, the installation procedure, and a description of the operation of the software package. Validation of the geometry and grid generation modules of ICEG2D is also discussed.

Author

Applications Programs (Computers); Software Development Tools; Prediction Analysis Techniques; Aircraft Icing; Computational Fluid Dynamics; Computerized Simulation; Algorithms

20000021583 NASA Langley Research Center, Hampton, VA USA

Subsonic Investigation of Leading-Edge Flaps Designed for Vortex- and Attached-Flow on a High-Speed Civil Transport Configuration

Campbell, Bryan A., NASA Langley Research Center, USA; Kemmerly, Guy T., NASA Langley Research Center, USA; Kjerstad, Kevin J., NASA Langley Research Center, USA; Lessard, Victor R., Vigyan Research Associates, Inc., USA; December 1999; 108p; In English

Contract(s)/Grant(s): RTOP 537-03-22-02

Report No.(s): NASA/TM-1999-209701; NAS 1.15:209701; L-17919; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

A wind tunnel investigation of two separate leading-edge flaps, designed for vortex and attached-flow, respectively, were conducted on a High Speed Civil Transport (HSCT) configuration in the Langley 14- by 22-Foot Subsonic Tunnel. Data were obtained over a Mach number range of 0.12 to 0.27, with corresponding chord Reynolds numbers of 2.50 x 10 (sup 6) to 5.50 x 10 (sup 6). Variations of the leading-edge flap deflection angle were tested with outboard leading-edge flaps deflected 0 deg. and 26.4 deg. Trailing-edge flaps were deflected 0 deg., 10 deg., 12.9 deg., and 20 deg. The longitudinal and lateral aerodynamic data are presented without analysis. A complete tabulated data listing is also presented herein. The data associated with each deflected leading-edge flap indicate L/D improvements over the undeflected configuration. These improvements may be instrumental in providing the necessary lift augmentation required by an actual HSCT during the climb-out and landing phases of the flight envelope. However, further tests will have to be done to assess their full potential.

Author

Subsonic Wind Tunnels; Leading Edge Flaps; Vortices; Supersonic Transports; Aerodynamic Configurations; Separated Flow

20000023168 NASA Ames Research Center, Moffett Field, CA USA

Aerodynamic Spring and Damping of Free-Pitching Tips on a Semispan Wing

Young, Larry A., NASA Ames Research Center, USA; Martin, Daniel M., Sterling Software, Inc., USA; [1992]; 19p; In English; Dynamics Specialist Conference, 16-17 Apr. 1992, Dallas, TX, USA; Sponsored by American Inst. of Aerodynamics and Astronautics, USA

Report No.(s): AIAA Paper 92-2111; Copyright Waived; Avail: CASI; A03, Hardcopy; A01, Microfiche

A test was conducted in the NASA Ames 7- by 10-Foot Wind Tunnel to derive aerodynamic spring and damping estimates for free-pitching tips on a semispan wing. The test model was a rectangular planform semispan wing with wing tips that had a single rigid-body pitch degree of freedom with respect to the inboard wing. A number of different tip planform geometries were tested, incorporating a range of quarter-chord sweep angles and taper ratios. The wing-tip dynamic response characteristics were measured at several wing angles of attack and tunnel dynamic pressures. The tip oscillations were initiated by releasing the tips from prescribed angles of attack. A new method to isolate Coulomb damping from aerodynamic damping from these tip-motion time histories is developed and applied. Correlations were performed between the experimentally derived wing-tip aerodynamic spring and damping values and predictions from a semiempirical analysis based on steady-state tip aerodynamic loads.
Author

Springs (Elastic); Damping; Wings; Wind Tunnel Tests; Pitch (Inclination)

20000023177 NASA Langley Research Center, Hampton, VA USA

Subsonic Investigation of a Leading-Edge Boundary Layer Control Suction System on a High-Speed Civil Transport Configuration

Campbell, Bryan A., NASA Langley Research Center, USA; Applin, Zachary T., NASA Langley Research Center, USA; Kemmerly, Guy T., NASA Langley Research Center, USA; Coe, Paul L., Jr., NASA Langley Research Center, USA; Owens, D. Bruce, NASA Langley Research Center, USA; Gile, Brenda E., NASA Langley Research Center, USA; Parikh, Pradip G., Boeing Co., USA; Smith, Don, Boeing Co., USA; December 1999; 134p; In English

Contract(s)/Grant(s): RTOP 537-03-22-02

Report No.(s): NASA/TM-1999-209700; L-17917; NAS 1.15:209700; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

A wind tunnel investigation of a leading edge boundary layer control system was conducted on a High Speed Civil Transport (HSCT) configuration in the Langley 14- by 22-Foot Subsonic Tunnel. Data were obtained over a Mach number range of 0.08 to 0.27, with corresponding chord Reynolds numbers of 1.79 x 10(exp 6) to 5.76 x 10(exp 6). Variations in the amount of suction, as well as the size and location of the suction area, were tested with outboard leading edge flaps deflected 0 and 30 deg and trailing-edge flaps deflected 0 and 20 deg. The longitudinal and lateral aerodynamic data are presented without analysis. A complete tabulated data listing is also presented herein.
Author

Boundary Layer Control; Leading Edges; Wind Tunnel Tests; Flaps (Control Surfaces); Pressure Effects; Subsonic Speed; Supersonic Transports; Aerodynamic Configurations

20000023178 NASA Glenn Research Center, Cleveland, OH USA

An Experimental Study of Turbulent Skin Friction Reduction in Supersonic Flow Using a Microblowing Technique

Hwang, Danny P., NASA Glenn Research Center, USA; December 1999; 12p; In English; 38th Aerospace Sciences Meeting and Exhibit, 10-13 Jan. 2000, Reno, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Contract(s)/Grant(s): RTOP 523-36-13

Report No.(s): NASA/TM-1999-209632; E-11959; AIAA Paper 2000-0545; NAS 1.15:209632; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A new turbulent skin friction reduction technology, called the microblowing technique has been tested in supersonic flow (Mach number of 1.9) on specially designed porous plates with microholes. The skin friction was measured directly by a force balance and the boundary layer development was measured by a total pressure rake at the tailing edge of a test plate. The free stream Reynolds number was 1.0(10 exp 6) per meter. The turbulent skin friction coefficient ratios (C(sub f)/C(sub f0)) of seven porous plates are given in this report. Test results showed that the microblowing technique could reduce the turbulent skin friction in supersonic flow (up to 90 percent below a solid flat plate value, which was even greater than in subsonic flow).
Author

Skin Friction; Friction Reduction; Turbulent Flow; Supersonic Flow; Porous Plates

20000024815 NASA Langley Research Center, Hampton, VA USA

1999 NASA High-Speed Research Program Aerodynamic Performance Workshop, Volume 2, High Lift

Hahne, David E., Editor, NASA Langley Research Center, USA; 1999 NASA High-Speed Research Program Aerodynamic Performance Workshop; December 1999; 562p; In English; 1999 NASA High-Speed Research Program Aerodynamic Performance Workshop, 8-12 Feb. 1999, Anaheim, CA, USA; Sponsored by NASA, USA; See also 20000024816 through 20000024823

Contract(s)/Grant(s): RTOP 537-07-51-10

Report No.(s): NASA/CP-1999-209704/VOL2/PT1; L-17911C; NAS 1.55:209704/VOL2/PT1; No Copyright; Avail: CASI; A24, Hardcopy; A04, Microfiche

The High-Speed Research Program sponsored the NASA High-Speed Research Program Aerodynamic Performance Review on February 8-12, 1999 in Anaheim, California. The review was designed to bring together NASA and industry High-Speed Civil Transport (HSCT) Aerodynamic Performance technology development participants in areas of: Configuration Aerodynamics (transonic and supersonic cruise drag prediction and minimization) and High-Lift. The review objectives were to: (1) report the progress and status of HSCT aerodynamic performance technology development; (2) disseminate this technology within the appropriate technical communities; and (3) promote synergy among the scientist and engineers working HSCT aerodynamics. The HSR AP Technical Review was held simultaneously with the annual review of the following airframe technology areas: Materials and Structures, Environmental Impact, Flight Deck, and Technology Integration Thus, a fourth objective of the Review was to promote synergy between the Aerodynamic Performance technology area and the other technology areas within the airframe element of the HSR Program. This Volume 2/Part 1 publication presents the High-Lift Configuration Development session.

Author

Civil Aviation; Supersonic Transports; Performance Prediction; Aerodynamic Configurations; Wind Tunnel Tests; Aerodynamic Stability

20000024816 NASA Ames Research Center, Moffett Field, CA USA

Data Corrections and Wind-Tunnel Data Comparisons of a 5% TCA Model in the NASA Ames 12-ft Pressure Tunnel

Zuniga, Fanny A., NASA Ames Research Center, USA; 1999 NASA High-Speed Research Program Aerodynamic Performance Workshop; December 1999; Volume 2, Part 1, pp. 1-56; In English; See also 20000024815; No Copyright; Avail: CASI; A04, Hardcopy; A04, Microfiche

The objectives of this research are: 1) to determine the effect of geometric variations near the inboard leading-edge flap on high-lift and stability and control performance data; 2) to determine Re effects on TCA (Technology Concept Aircraft) high-lift configuration for optimum high-lift and stability and control performance at takeoff, climbout, approach and landing conditions; and 3) to obtain flow-visualization data on upper surface of wing for CFD validations. This paper is presented in viewgraph form.

CASI

Wind Tunnel Tests; Computational Fluid Dynamics; Aircraft Models; Data Processing; Aircraft Configurations

20000024817 Boeing Co., Phantom Works, Long Beach, CA USA

Wind Tunnel Test of a 5% HSCT (TCA) Model in the NASA Ames 12-ft Pressure Tunnel

Edwards, Robin, Boeing Co., USA; Clark, Roger, Boeing Co., USA; Yeh, David, Boeing Co., USA; Polito, Ryan, Boeing Co., USA; 1999 NASA High-Speed Research Program Aerodynamic Performance Workshop; December 1999; Volume 2, Part 1, pp. 57-158; In English; See also 20000024815; No Copyright; Avail: CASI; A06, Hardcopy; A04, Microfiche

The objectives of this research are: 1) to determine the effect of geometric variations of the inboard leading edge flap on high lift, stability and control performance data; 2) to determine the Reynolds number effects on TCA (Technology Concept Aircraft) high lift configuration for optimum high-lift and stability and control performance at take-off, climbout, approach and landing conditions; and 3) Obtain flow visualization data on the upper surface of the wing for CFD validation and flow physics. This paper is presented in viewgraph form.

CASI

Wind Tunnel Tests; Aircraft Configurations; Civil Aviation; Computational Fluid Dynamics; Aircraft Models; Supersonic Transports

20000024818 Boeing Co., Phantom Works, Long Beach, CA USA

Wind Tunnel Test of a 5% HSCT (TCA) Model in the NASA Ames 12-ft Pressure Tunnel (Stability and Control Summary)

Glessner, Paul T., Boeing Co., USA; Kubiatko, Paul, Boeing Co., USA; 1999 NASA High-Speed Research Program Aerodynamic Performance Workshop; December 1999; Volume 2, Part 1, pp. 159-189; In English; See also 20000024815; No Copyright; Avail: CASI; A03, Hardcopy; A04, Microfiche

The test objectives of the Ames 12' (TCA-3) test were to: 1) determine the effect of geometric variations of the inboard leading edge flap on high-lift (HL) performance and stability & control (S&C) characteristics, 2) determine Re effects on the Technology Concept Airplane (TCA) configuration for optimum performance at takeoff (TO), climbout (CO), approach (AP), and landing (LDG) conditions, 3) obtain flow-visualization (flo-viz) data on the upper surface of the wing for comparison to computational fluid dynamic (CFD) results, 4) obtain video deformation and pressure sensitive paint (PSP) data. Additionally, data obtained at low Reynolds number could be compared to data obtained on similar configurations in the NASA LaRC 14' x 22' (LaRC 449) to evaluate model installation effects and data correction trends between the two facilities.
Author
Wind Tunnel Tests; Aerodynamic Stability; Civil Aviation; Supersonic Transports; Aircraft Models; Computational Fluid Dynamics

20000024819 Boeing Commercial Airplane Co., Seattle, WA USA
TCA-4/NASA473 Test Results: A High-Lift and Stability and Control Test of the HSR 5% Model Including Planform Variations, Canard and 3-Surface Configurations
Elzey, Michael B., Boeing Commercial Airplane Co., USA; Griffiths, Robert C., Boeing Commercial Airplane Co., USA; 1999 NASA High-Speed Research Program Aerodynamic Performance Workshop; December 1999; Volume 2, Part 1, pp. 191-375; In English; See also 20000024815; No Copyright; Avail: CASI; A09, Hardcopy; A04, Microfiche

This material is presented as follows: First, test objectives and background are discussed. Background material includes part description, test statistics and progress made. Second, general test results ware discussed, including data quality and test-to-test comparisons. Third, high-lift results are presented, followed by stability and control. Each section summarizes respective conclusions. Finally, general recommendations are presented and discussed.
Author
Canard Configurations; Aerodynamic Stability; Aircraft Models; Wind Tunnel Tests; Planforms; Lift

20000024820 Boeing Commercial Airplane Co., Seattle, WA USA
TCA Final Assessment and Test/Theory Comparisons for Sealed Slats
Chen, Allen W., Boeing Commercial Airplane Co., USA; 1999 NASA High-Speed Research Program Aerodynamic Performance Workshop; December 1999; Volume 2, Part 1, pp. 377-439; In English; See also 20000024815; No Copyright; Avail: CASI; A04, Hardcopy; A04, Microfiche

This paper presents the TCA Final Assessment and Test/Theory comparisons for Sealed Slats. The topics include: 1) Review of exit criteria for TCA (Technology Concept Airplane) final assessment; 2) Summary of TCA assessment; 3) Process for assessment; 4) Review of Wind Tunnel Data; 5) Assessment; 6) Seal Slats; and 7) Conclusions and recommendations. This paper is presented in viewgraph form.
CASI
Technology Assessment; Wind Tunnel Tests; Seals (Stoppers); Aerodynamic Configurations

20000024821 Boeing Commercial Airplane Co., High Lift Aerodynamics, Seattle, WA USA
HSR Leading Edge Trade Study
Burggraf, Warren, Boeing Commercial Airplane Co., USA; 1999 NASA High-Speed Research Program Aerodynamic Performance Workshop; December 1999; Volume 2, Part 1, pp. 441-476; In English; See also 20000024815; No Copyright; Avail: CASI; A03, Hardcopy; A04, Microfiche

The motivation of this study was to improve the Lift to Drag ratio of the configuration at the critical climb-out condition and thereby reduce the climb-out noise. Lift by itself is not the issue on this airplane but instead drag at the climb-out lift condition. This study concentrated on sealed leading edge devices with reductions in wing upper surface curvature when deflected. The reason for this was that recent wind tunnel tests and prior art have shown that these kinds of devices show superior lift to drag characteristics. The purpose of the study was to evaluate the impact/advantages relative to the plain flap leading edge of using a sealed slat or a variable camber leading edge on the PTC 1080-1494 wing. The study was an extension of a 1993 study in that new information and methods are now available which impacts the conclusions drawn, in particular new wind tunnel data and new analytical tools (NSU2D). Aerodynamics, Structures, Mech/Elec Systems, Weights, and Aero Performance participated in the study.
Derived from text
Wind Tunnel Tests; Aerodynamic Configurations; Supersonic Speed; Leading Edge Flaps; Computational Fluid Dynamics

20000024822 Boeing Co., Phantom Works, Long Beach, CA USA

TCA 2.8-38 Outboard LE Flap Chord Study (and Sliding Hingeline Fairings)

Powell, Art, Boeing Co., USA; 1999 NASA High-Speed Research Program Aerodynamic Performance Workshop; December 1999; Volume 2, Part 1, pp. 477-513; In English; See also 20000024815; No Copyright; Avail: CASI; A03, Hardcopy; A04, Microfiche

This paper is a brief discussion of some work that was undertaken by the author in support of HSCT high lift technology development. The configuration studied is basically the PTC, but with the 2.8-38 wing. The 2.8-38 wing features a high-aspect-ratio low-sweep outer panel, occupying the outermost 50% semi-span. This panel is of necessity quite thin, and therefore heavy, so reducing leading-edge flap chord there has the potential for reducing wing weight by enlarging the wing structural box. TCA-4 experimental oil-flow surface streamline pictures show attached or nearly attached flow over the outer panel at the nearly-optimal 30 degree leading-edge flap deflection and 10 degrees angle-of-attack. Whether or not the leading-edge flap chord could be reduced further depends on whether hingeline separation can be prevented by some means.
Author

Leading Edge Flaps; Supersonic Transports; Chords (Geometry); Aerodynamic Configurations; Hinges

20000024823 Boeing Commercial Airplane Co., High Lift Aerodynamics, Seattle, WA USA

Impact of Wing Planform, Canard, and Leading Edge Flap Type on High Lift Performance and Technology Projection

Meredith, Paul, Boeing Commercial Airplane Co., USA; 1999 NASA High-Speed Research Program Aerodynamic Performance Workshop; December 1999; Volume 2, Part 1, pp. 515-550; In English; See also 20000024815; No Copyright; Avail: CASI; A03, Hardcopy; A04, Microfiche

This paper presents the Impact of Wing Planform, Canard, and Leading Edge Flap Type on High Lift Performance and Technology Projection. This paper is presented in viewgraph form. The topics include: 1) L/D Summary; 2) Full Scale Drag Build-ups (Effects of Wing Planform, Canards, and Sealed Slats); 3) Technology Projection (Components of Drag, Limits on Suction Parameter); 4) High Lift Metrics AP-3 and AP-4; and 5) Conclusions and Recommendations.
CASI

Wing Planforms; Canard Configurations; Leading Edge Flaps; Wind Tunnel Tests; Technology Assessment; Lift

20000024854 NASA Langley Research Center, Hampton, VA USA

Aerodynamic Characteristics, Database Development and Flight Simulation of the X-34 Vehicle

Pamadi, Bandu N., NASA Langley Research Center, USA; Brauckmann, Gregory J., NASA Langley Research Center, USA; Ruth, Michael J., Orbital, USA; Fuhrmann, Henri D., Orbital, USA; [2000]; 18p; In English; 38th; 38th Aerospace Sciences, 10-13 Jan. 2000, Reno, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Report No.(s): AIAA Paper 2000-0900; Copyright Waived; Avail: CASI; A03, Hardcopy; A01, Microfiche

An overview of the aerodynamic characteristics, development of the preflight aerodynamic database and flight simulation of the NASA/Orbital X-34 vehicle is presented in this paper. to develop the aerodynamic database, wind tunnel tests from subsonic to hypersonic Mach numbers including ground effect tests at low subsonic speeds were conducted in various facilities at the NASA Langley Research Center. Where wind tunnel test data was not available, engineering level analysis is used to fill the gaps in the database. Using this aerodynamic data, simulations have been performed for typical design reference missions of the X-34 vehicle.
Author

Wind Tunnel Tests; Aerodynamic Characteristics; Data Bases; Flight Simulation; Data Simulation

20000024908 NASA Langley Research Center, Hampton, VA USA

Piloted Simulation Study of the Effects of High-Lift Aerodynamics on the Takeoff Noise of a Representative High-Speed Civil Transport

Glaab, Louis J., Lockheed Engineering and Sciences Co., USA; Riley, Donald R., NASA Langley Research Center, USA; Brandon, Jay M., NASA Langley Research Center, USA; Person, Lee H., Jr., NASA Langley Research Center, USA; Glaab, Patricia C., Unisys Corp., USA; December 1999; 52p; In English
Contract(s)/Grant(s): RTOP 537-03-22-01
Report No.(s): NASA/TP-1999-209696; NAS 1.60:209696; L-17220; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

As part of an effort between NASA and private industry to reduce airport-community noise for high-speed civil transport (HSCT) concepts, a piloted simulation study was initiated for the purpose of predicting the noise reduction benefits that could result from improved low-speed high-lift aerodynamic performance for a typical HSCT configuration during takeoff and initial climb. Flight profile and engine information from the piloted simulation were coupled with the NASA Langley Aircraft Noise

Prediction Program (ANOPP) to estimate jet engine noise and to propagate the resulting source noise to ground observer stations. A baseline aircraft configuration, which also incorporated different levels of projected improvements in low-speed high-lift aerodynamic performance, was simulated to investigate effects of increased lift and lift-to-drag ratio on takeoff noise levels. Simulated takeoff flights were performed with the pilots following a specified procedure in which either a single thrust cutback was performed at selected altitudes ranging from 400 to 2000 ft, or a multiple-cutback procedure was performed where thrust was reduced by a two-step process. Results show that improved low-speed high-lift aerodynamic performance provides at least a 4 to 6 dB reduction in effective perceived noise level at the FAA downrange flyover measurement station for either cutback procedure. However, improved low-speed high-lift aerodynamic performance reduced maximum sideline noise levels only when using the multiple-cutback procedures.
Author
Pilot Support Systems; Computerized Simulation; Takeoff; Noise Intensity; Aerodynamic Noise; Aircraft Configurations; Noise Prediction (Aircraft); Noise Reduction; Lift

20000024913 Department of the Air Force, Washington, DC USA
General Flight Test Theory Applied to Aircraft Modifications
Alford, Lionel D.; Knarr, Robert C.; Jan. 1999; 12p; In English
Report No.(s): AD-A371942; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
Any external aircraft modification has potentially far-reaching effects on the capability of the aircraft to succeed or fail in its mission. The authors take a systematic look at the effects that small changes can have upon the whole, with a series of examples that demonstrate why careful review of data or testing is often vital in the assessment of system modifications.
DTIC
Flight Tests; Revisions; Aircraft Design

20000025039 Boeing Commercial Space Co., Seattle, WA USA
Acoustic and Aerothermal Performance Test of the Axisymmetric Coannular Ejector Nozzle, Volume 2, Acoustic Performance *Final Report*
Herkes, William, Boeing Commercial Space Co., USA; February 2000; 118p; In English
Contract(s)/Grant(s): NAS3-25963; RTOP 714-04-50
Report No.(s): NASA/CR-2000-209813/VOL2; NAS 1.26:209813/VOL2; E-12122; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche
Acoustic and propulsion performance testing of a model-scale Axisymmetric Coannular Ejector nozzle was conducted in the Boeing Low-speed Aeroacoustic Facility. This nozzle is a plug nozzle with an ejector design to provide aspiration of about 20% of the engine flow. A variety of mixing enhancers were designed to promote mixing of the engine and the aspirated flows. These included delta tabs, tone-injection rods, and wheeler ramps. This report addresses the acoustic aspects of the testing. The spectral characteristics of the various configurations of the nozzle are examined on a model-scale basis. This includes indentifying particular noise sources contributing to the spectra and the data are projected to full-scale flyover conditions to evaluate the effectiveness of the nozzle, and of the various mixing enhancers, on reducing the Effective Perceived Noise Levels.
Author
Acoustic Properties; Aeroacoustics; Effective Perceived Noise Levels; Noise Reduction; Performance Tests; Plug Nozzles; Ejectors; Aerodynamic Noise; Jet Aircraft Noise; Wind Tunnel Tests

20000025060 Maritime Research Inst. Netherlands, Wageningen, Netherlands
The Design and Testing of a Propeller with an Extreme Radial Load Distribution
Holtrol, Ir J., Maritime Research Inst. Netherlands, Netherlands; October 1999; 43p; In English; original contains color illustrations
Contract(s)/Grant(s): A97/KM/122
Report No.(s): TD99-0379; Rept-12958-1-CT; Copyright; Avail: Issuing Activity
In this report the design and model tests are presented for a slowly rotating propeller with extremely unloaded blade tips. The design parameters with this slowly rotating propeller have led to an extreme radial gradient of the circulation. The experiments were made to examine in which conditions trailing vortex cavitation starts when the actual blade tip is free of tip-vortex cavitation. The experiments have indicated that there is a need for a rule for the inception of leading-edge vortex cavitation.
Author
Design Analysis; Propellers; Propeller Blades; Blade Tips; Radial Distribution

20000025188 Utah State Univ., Mechanical and Aerospace Engineering Dept., Logan, UT USA
Experimental Study of the Structure of a Wingtip Vortex, *Feb. 1998 - Dec. 1999*
Anderson, Elgin A., Utah State Univ., USA; Wright, Christopher T., Utah State Univ., USA; February 2000; 63p; In English
Contract(s)/Grant(s): NAG1-1999; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

A complete look at the near-field development and subsequent role-up of a wingtip vortex from a NACA 0015 wing section is investigated. Two separate but equally important surveys of the vortex structure in the region adjacent to the wingtip and approximately one chord length downstream of the trailing edge are performed. The two surveys provide qualitative flow-visualization an quantitative velocity measurement data. The near-field development and subsequent role-up of the vortex structures is strongly influenced by the angle-of-attack and the end-cap treatment of the wing section. The velocity field near the wingtip of the NACA 0015 wing section was measured with a triple-sensor hot wire probe and compared to flow visualization images produced with titanium tetrachloride smoke injection and laser illumination. The flat end-cap results indicate the formation of multiple, relatively strong vortex structures as opposed to the formation of a single vortex produced with the round end-cap. The multiple vortices generated by the flat end-cap are seen to rotate around a common ce te in a helical pattern until they eventually merge into a single vortex. Compared to a non-dimensional loading parameter, the results of the velocity and flow visualization data shows a "jetlike" axial velocity profile for loading parameter values on the order of 0.1 and a "wakelike" profile for much lower loading parameter values.
Author
Wing Tips; Vortices; Subsonic Wind Tunnels; Aerodynamic Configurations; Aerodynamic Characteristics

20000025200 Vigyan Research Associates, Inc., Hampton, VA USA
Computational Assessment of Aft-Body Closure for the HSR Reference H Configuration
Londenberg, W. Kelly, Vigyan Research Associates, Inc., USA; December 1999; 42p; In English
Contract(s)/Grant(s): NAS1-19672; RTOP 537-07-20-03
Report No.(s): NASA/CR-1999-209521; NAS 1.26:209521; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A study has been conducted to determine how well the USM3D unstructured Euler solver can be utilized to predict the flow over the High Speed Research (HSR) Reference H configuration with an ultimate goal of prediction of Sting interference so after body closure effects may be evaluated. This study has shown that the code can be used to predict the interference effects of a lower mounted blade sting with a high degree of confidence. It has been shown that wing and fuselage pressures, both levels and trends, can be predicted well. Force and moment levels are not predicted well but experimental trends are predicted. Based upon this, predicted force and moment increments are assumed to be predicted accurately. Deflection of the horizontal tail was found to cause a non-linear increment from the non-deflected sting interference effects.
Author
Afterbodies; Closures; Aerodynamic Configurations

20000025206 NASA Langley Research Center, Hampton, VA USA
Investigation of Vortex Flaps and Other Flow Control Devices on Generic High-Speed Civil Transport Planforms
Kjerstad, Kevin J., NASA Langley Research Center, USA; Campbell, Bryan A., NASA Langley Research Center, USA; Gile, Brenda E., NASA Langley Research Center, USA; Kemmerly, Guy T., NASA Langley Research Center, USA; December 1999; 126p; In English
Contract(s)/Grant(s): RTOP 537-03-22-02
Report No.(s): NASA/TP-1999-209537; NAS 1.60:209537; L-17458; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

A parametric cranked delta planform study has been conducted in the Langley 14- by 22-Foot Subsonic Tunnel with the following objectives: (1) to evaluate the vortex flap design methodology for cranked delta wings, (2) to determine the influence of leading-edge sweep and the outboard wing on vortex flap effectiveness, (3) to evaluate novel flow control concepts, and (4) to validate unstructured grid Euler computer code predictions with modeled vortex and trailing-edge flaps. Two families of cranked delta planforms were investigated. One family had constant aspect ratio, while the other had a constant nondimensional semispan location of the leading-edge break. The inboard leading-edge sweep of the planforms was varied between 68 deg., 71 deg., and 74 deg., while outboard leading-edge sweep was varied between 48 deg. and 61 deg. Vortex flaps for the different planforms were designed by an analytical vortex flap design method. The results indicate that the effectiveness of the vortex flaps was only slightly influenced by the variations in the parametric planforms. The unstructured grid Euler computer code was successfully used to model the configurations with vortex flaps. The vortex trap concept was successfully demonstrated.
Author
Vortex Flaps; High Speed; Planforms; Subsonic Wind Tunnels; Computational Fluid Dynamics; Control Surfaces; Civil Aviation

20000025235 NASA Glenn Research Center, Cleveland, OH USA

SmaggIce: Surface Modeling and Grid Generation for Iced Airfoils: Phase 1 Results

Vickerman, Mary B., NASA Glenn Research Center, USA; Choo, Yung K., NASA Glenn Research Center, USA; Braun, Donald C., NASA Glenn Research Center, USA; Baez, Marivell, NASA Glenn Research Center, USA; Gnepp, Steven, NASA Glenn Research Center, USA; December 1999; 20p; In English; 38th; 38th Aerospace Sciences Meeting, 10-13 Jan. 2000, Reno, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Contract(s)/Grant(s): RTOP 548-20-23

Report No.(s): NASA/TM-1999-209678; NAS 1.15:209678; AIAA Paper 2000-0235; E-12033; Copyright Waived; Avail: CASI; A03, Hardcopy; A01, Microfiche

SmaggIce (Surface Modeling and Grid Generation for Iced Airfoils) is a software toolkit used in the process of aerodynamic performance prediction of iced airfoils with grid-based Computational Fluid Dynamics (CFD). It includes tools for data probing, boundary smoothing, domain decomposition, and structured grid generation and refinement. SmaggIce provides the underlying computations to perform these functions, a GUI (Graphical User Interface) to control and interact with those functions, and graphical displays of results, it is being developed at NASA Glenn Research Center. This paper discusses the overall design of SmaggIce as well as what has been implemented in Phase 1. Phase 1 results provide two types of software tools: interactive ice shape probing and interactive ice shape control. The ice shape probing tools will provide aircraft icing engineers and scientists with an interactive means to measure the physical characteristics of ice shapes. On the other hand, the ice shape control features of SmaggIce will allow engineers to examine input geometry data, correct or modify any deficiencies in the geometry, and perform controlled systematic smoothing to a level that will make the CFD process manageable.

Author

Software Development Tools; Computational Fluid Dynamics; Grid Generation (Mathematics); Airfoils; Aircraft Icing; Computer Aided Design

20000025329 NASA Langley Research Center, Hampton, VA USA

Low-Speed Stability-and-Control and Ground-Effects Measurements on the Industry Reference High Speed Civil Transport

Kemmerly, Guy T., NASA Langley Research Center, USA; Campbell, Bryan A., NASA Langley Research Center, USA; Banks, Daniel W., NASA Langley Research Center, USA; Yaros, Steven F., NASA Langley Research Center, USA; December 1999; 188p; In English

Contract(s)/Grant(s): RTOP 537-03-22-02

Report No.(s): NASA/TM-1999-209702; NAS 1.15:209702; L-17920; No Copyright; Avail: CASI; A09, Hardcopy; A02, Microfiche

As a part of a national effort to develop an economically feasible High Speed Civil Transport (HSCT), a single configuration has been accepted as the testing baseline by the organizations working in the High Speed Research (HSR) program. The configuration is based on a design developed by the Boeing Company and is referred to as the Reference H (Ref H). The data contained in this report are low-speed stability-and-control and ground-effect measurements obtained on a 0.06 scale model of the Ref H in a subsonic tunnel.

Author

Civil Aviation; High Speed; Subsonic Wind Tunnels; Ground Effect (Aerodynamics); Low Speed Stability; Control Surfaces

20000025330 Virginia Polytechnic Inst. and State Univ., Blacksburg, VA USA

A Computational Model for Rotor-Fuselage Interactional Aerodynamics

Boyd, D. Douglas, Jr., Virginia Polytechnic Inst. and State Univ., USA; Barnwell, Richard W., Virginia Polytechnic Inst. and State Univ., USA; Gorton, Susan Althoff, Army Aviation and Missile Command, USA; 2000; 11p; In English; 38th; Aerospace Sciences, 10-13 Jan. 2000, Reno, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Report No.(s): AIAA Paper 2000-0256; Copyright Waived; Avail: CASI; A03, Hardcopy; A01, Microfiche

A novel unsteady rotor-fuselage interactional aerodynamics model has been developed. This model loosely couples a Generalized Dynamic Wake Theory (GDWT) to a thin-layer Navier-Stokes solution procedure. This coupling is achieved using an unsteady pressure jump boundary condition in the Navier-Stokes model. The new unsteady pressure jump boundary condition models each rotor blade as a moving pressure jump which travels around the rotor azimuth and is applied between two adjacent planes in a cylindrical, non-rotating grid. Comparisons are made between measured and predicted time-averaged and

time-accurate rotor inflow ratios. Additional comparisons are made between measured and predicted unsteady surface pressures on the top centerline and sides of the fuselage.
Author
Interactional Aerodynamics; Rotor Aerodynamics; Fuselages

20000025331 NASA Langley Research Center, Hampton, VA USA
Unsteady Slat-Wake Characteristics of a High-Lift Configuration
Paschal, Keith, NASA Langley Research Center, USA; Jenkins, Luther, NASA Langley Research Center, USA; Yao, Chungsheng, NASA Langley Research Center, USA; [2000]; 12p; In English; 38th; 38th Aerospace Sciences Meeting, 10-13 Jan. 2000, Reno, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA; Original contains color illustrations
Report No.(s): AIAA Paper 2000-0139; Copyright Waived; Avail: CASI; A03, Hardcopy; A01, Microfiche

Unsteady characteristics of the slat wake associated with a three-element high-lift model were investigated with Particle Image Velocimetry (PIV). The test was conducted in the NASA Langley Basic Aerodynamic Research Tunnel (BART) employing sidewall blowing to maintain 2-D flow over the high-lift configuration. The main goal of the experiment was to document spatial characteristics of the unsteady slat wake in an effort to further guide computational efforts. PIV measurements were made at 4, 8, and 10 degrees angle of attack. Instantaneous vector maps revealed organized structures that had been ejected from the slat cove merging with the slat wake. This phenomenon is attributed to the unsteadiness of the recirculation region in the slat cove. The unsteadiness is most pronounced at 4 degrees. Mean data show a wide, diffuse wake at 4 degrees that becomes both narrow and well defined at 10 degrees angle of attack. Second-order statistics suggest a similar trend. These statistics show higher levels of fluctuations due to slat cove unsteadiness and turbulence at 4 degrees, while the slat cove flow has apparently stabilized at the higher angles of attack.
Author
Aerodynamic Configurations; Angle of Attack; Wakes; Wind Tunnel Tests; Airfoils; Two Dimensional Flow; Lift

20000025332 NASA Langley Research Center, Hampton, VA USA
Large Eddy Simulation of Wake Vortices in the Convective Boundary Layer
Lin, Yuh–Lang, North Carolina State Univ., USA; Han, Jongil, North Carolina State Univ., USA; Zhang, Jing, North Carolina State Univ., USA; Ding, Feng, North Carolina State Univ., USA; Arya, S. Pal, North Carolina State Univ., USA; Proctor, Fred H., NASA Langley Research Center, USA; [2000]; 9p; In English; 38th; 38th Aerospace Sciences Meeting, 10-13 Jan. 2000, Reno, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Contract(s)/Grant(s): NAS1-18925; NCC1-188
Report No.(s): AIAA Paper 2000-0753; Copyright Waived; Avail: CASI; A02, Hardcopy; A01, Microfiche

The behavior of wake vortices in a convective boundary layer is investigated using a validated large eddy simulation model. Our results show that the vortices are largely deformed due to strong turbulent eddy motion while a sinusoidal Crow instability develops. Vortex rising is found to be caused by the updrafts (thermals) during daytime convective conditions and increases with increasing nondimensional turbulence intensity eta. In the downdraft region of the convective boundary layer, vortex sinking is found to be accelerated proportional to increasing eta, with faster speed than that in an ideal line vortex pair in an inviscid fluid. Wake vortices are also shown to be laterally transported over a significant distance due to large turbulent eddy motion. On the other hand, the decay rate of the, vortices in the convective boundary layer that increases with increasing eta, is larger in the updraft region than in the downdraft region because of stronger turbulence in the updraft region.
Author
Boundary Layers; Convection; Inviscid Flow; Large Eddy Simulation; Vertical Air Currents; Vortices; Wakes; Convective Flow

20000025334 NASA Glenn Research Center, Cleveland, OH USA
Numerical Analysis of the Trailblazer Inlet Flowfield for Hypersonic Mach Numbers
Steffen, C. J., Jr., NASA Glenn Research Center, USA; DeBonis, J. R., NASA Glenn Research Center, USA; December 1999; 18p; In English; 38th; 38th Aerospace Sciences Meeting, 10-13 Jan. 2000, Reno, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Contract(s)/Grant(s): RTOP 523-31-13
Report No.(s): NASA/TM-1999-209654; NAS 1.15:209654; AIAA Paper 2000-0889; E-12010; Copyright Waived; Avail: CASI; A03, Hardcopy; A01, Microfiche

A study of the Trailblazer vehicle inlet was conducted using the Global Air Sampling Program (GASP) code for flight Mach numbers ranging from 4-12. Both perfect gas and finite rate chemical analysis were performed with the intention of making detailed comparisons between the two results. Inlet performance was assessed using total pressure recovery and kinetic energy

efficiency. These assessments were based upon a one-dimensional stream-thrust-average of the axisymmetric flowfield. Flow visualization utilized to examine the detailed shock structures internal to this mixed-compression inlet. Kinetic energy efficiency appeared to be the least sensitive to differences between the perfect gas and finite rate chemistry results. Total pressure recovery appeared to be the most sensitive discriminator between the perfect gas and finite rate chemistry results for flight Mach numbers above Mach 6. Adiabatic wall temperature was consistently overpredicted by the perfect gas model for flight Mach numbers above Mach 4. The predicted shock structures were noticeably different for Mach numbers from 6-12. At Mach 4, the perfect gas and finite rate chemistry models collapse to the same result.
Author
Flow Distribution; Numerical Analysis; Engine Inlets

20000025393 NASA Johnson Space Center, Houston, TX USA
Thermal Analysis of the X-38 Aft Fin During Re-Entry
Hong, Andrew E., NASA Johnson Space Center, USA; Ninth Thermal and Fluids Analysis Workshop Proceedings; November 1999, pp. 91-106; In English; See also 20000025387; No Copyright; Avail: CASI; A03, Hardcopy; A03, Microfiche

This document contains the details of the thermal analysis of the X-38 aft fin during re-entry. This analysis was performed in order to calculate temperature response of the aft fin components. This would be provided as input to a structural analysis and would also define the operating environment for the electromechanical actuator (EMA). The calculated structural temperature response would verify the performance of the thermal protection system (TPS). The geometric representation of the aft fin was derived from an I-DEAS finite element model that was used for structural analysis. The thermal mass network model was derived from the geometric representation.
Author
Thermal Analysis; X-38 Crew Return Vehicle; Reentry; Mathematical Models; Applications Programs (Computers)

20000025454 NASA Langley Research Center, Hampton, VA USA
Subsonic Aerodynamic Assessment of Vortex Flow Management Devices on a High-Speed Civil Transport Configuration
Campbell, Bryan A., NASA Langley Research Center, USA; Applin, Zachary T., NASA Langley Research Center, USA; Kemmerly, Guy T., NASA Langley Research Center, USA; December 1999; 112p; In English
Contract(s)/Grant(s): RTOP 537-03-22-02
Report No.(s): NASA/TP-1999-209693; L-17147; NAS 1.60:209693; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

An experimental investigation of the effects of leading-edge vortex management devices on the subsonic performance of a high-speed civil transport (HSCT) configuration was conducted in the Langley 14- by 22-Foot Subsonic Tunnel. Data were obtained over a Mach number range of 0.14 to 0.27, with corresponding chord Reynolds numbers of 3.08 x 10 (sup 6) to 5.47 x 10 (sup 6). The test model was designed for a cruise Mach number of 2.7. During the subsonic high-lift phase of flight, vortical flow dominates the upper surface flow structure, and during vortex breakdown, this flow causes adverse pitch-up and a reduction of usable lift. The experimental results showed that the beneficial effects of small leading-edge vortex management devices located near the model reference center were insufficient to substantially affect the resulting aerodynamic forces and moments. However, devices located at or near the wiring apex region demonstrated potential for pitch control with little effect on overall lift.
Author
Subsonic Wind Tunnels; High Speed; Civil Aviation; Supersonic Transports; Aerodynamic Characteristics; Vortices; Flow Distribution

20000025500 NASA Langley Research Center, Hampton, VA USA
Serrated-Planform Lifting-Surfaces
McGrath, Brian E., Inventor, NASA Langley Research Center, USA; Wood, Richard M., Inventor, NASA Langley Research Center, USA; May 11, 1999; In English
Patent Info.: Filed 22 Oct. 1996; NASA-Case-LAR-15295-1; US-Patent-5,901,925; US-Patent-Appl-SN-734820; No Copyright; Avail: US Patent and Trademark Office, Hardcopy

A novel set of serrated-planform lifting surfaces produce unexpectedly high lift coefficients at moderate to high angles-of-attack. Each serration, or tooth, is designed to shed a vortex. The interaction of the vortices greatly enhances the lifting capability over an extremely large operating range. Variations of the invention use serrated-planform lifting surfaces in planes different than that of a primary lifting surface. In an alternate embodiment, the individual teeth are controllably retractable and deployable to provide for active control of the vortex system and hence lift coefficient. Differential lift on multiple

serrated-planform lifting surfaces provides a means for vehicle control. The important aerodynamic advantages of the serrated-planform lifting surfaces are not limited to aircraft applications but can be used to establish desirable performance characteristics for missiles, land vehicles, and/or watercraft.
Official Gazette of the U.S. Patent and Trademark Office
Aerodynamic Coefficients; Angle of Attack; Planforms; Vortex Shedding; Lifting Bodies

20000025535 NASA Langley Research Center, Hampton, VA USA
A Factorial Data Rate and Dwell Time Experiment in the National Transonic Facility
DeLoach, R., NASA Langley Research Center, USA; 2000; 16p; In English; 38th; Aerospace Sciences, 2000, Reno, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Report No.(s): AIAA Paper 2000-0828; Copyright Waived; Avail: CASI; A03, Hardcopy; A01, Microfiche

This report is an introductory tutorial on the application of formal experiment design methods to wind tunnel testing, for the benefit of aeronautical engineers with little formal experiment design training. It also describes the results of a Study to determine whether increases in the sample rate and dwell time of the National Transonic Facility data system would result in significant changes in force and moment data. Increases in sample rate from 10 samples per second to 50 samples per second were examined, as were changes in dwell time from one second per data point to two seconds. These changes were examined for a representative aircraft model in a range of tunnel operating conditions defined by angles of attack from 0 deg to 3.8 deg, total pressure from 15.0 psi to 24.1 psi, and Mach numbers from 0.52 to 0.82. No statistically significant effect was associated with the change in sample rate. The change in dwell time from one second to two seconds affected axial force measurements, and to a lesser degree normal force measurements. This dwell effect comprises a "rectification error" caused by incomplete cancellation of the positive and negative elements of certain low frequency dynamic components that are not rejected by the one-Hz low-pass filters of the data system. These low frequency effects may be due to tunnel circuit phenomena and other sources. The magnitude of the dwell effect depends on dynamic pressure, with angle of attack and Mach number influencing the strength of this dependence. An analysis is presented which suggests that the magnitude of the rectification error depends on the ratio of measurement dwell time to the period of the low-frequency dynamics, as well as the amplitude of the dynamics. The essential conclusion of this analysis is that extending the dwell time (or, equivalently, replicating short-dwell data points) reduces the rectification error.
Author
Dwell; Time Dependence; Wind Tunnel Tests; Transonic Wind Tunnels; Rates (Per Time); Experiment Design; Aircraft Models

20000025555 Duke Univ., Dept. of Mechanical Engineering and Materials Science, Durham, NC USA
Reduced-Order Aerodynamic Model and Its Application to a Nonlinear Aeroelastic System
Tang, Deman, Duke Univ., USA; Conner, Mark D., Duke Univ., USA; Dowell, Earl H., Duke Univ., USA; Journal of Aircraft; March-April 1998; Volume 35, No. 2, pp. 332-338; In English
Contract(s)/Grant(s): F49620-97-1-0063; NAG1-1569; Copyright; Avail: Issuing Activity

Starting from a finite state model for a two-dimensional aerodynamic flow over an airfoil, the eigenmodes of the aerodynamic flow are determined. Using a small number of these aerodynamic eigenmodes, ie., a reduced-order model, the aeroelastic model is formed by coupling them to a typical section structural model with a trailing-edge flap. A free-play nonlinearity is modeled. Results are shown from the finite state model, the reduced-order model, and previous theoretical and experimental work. All results are in good agreement.
Author
Aeroelasticity; Mathematical Models; Aerodynamic Characteristics; Nonlinear Systems; Dynamic Models

20000025556 Duke Univ., Dept. of Mechanical Engineering and Materials Science, Durham, NC USA
Nonlinear Behavior of a Typical Airfoil Section with Control Surface Freeplay: A Numerical and Experimental Study
Conner, M. D., Duke Univ., USA; Tang, D. M., Duke Univ., USA; Dowell, E. H., Duke Univ., USA; Virgin, L. N., Duke Univ., USA; Journal of Fluids and Structures; 1997; ISSN 0889-9746; Volume 11, pp. 89-109; In English; Copyright; Avail: Issuing Activity

A three degree-of-freedom aeroelastic typical section with control surface freeplay is modeled theoretically as a system of piecewise linear state-space models. The system response is determined by time marching of the governing equations using a standard Runge-Kutta algorithm in conjunction with Henon's method for integrating a system of equations to a prescribed surface of phase space section. Henon's method is used to locate the "switching points" accurately and efficiently as the system moves from one linear region into another. An experimental model which closely approximates the three degree-of-freedom, typical section in two-dimensional, incompressible flow has been created to validate the theoretical model. Consideration is given to modeling realistically the structural damping present in the experimental system. The effect of the freeplay on the system response

is examined numerically and experimentally. The development of the state-space model offers a low-order, computationally efficient means of modeling fully the freeplay nonlinearity and may offer advantages in future research which will investigate the effects of freeplay on the control of flutter in the typical section.
Author
Airfoil Profiles; Control Surfaces; Dynamic Structural Analysis; Aircraft Structures

03
AIR TRANSPORTATION AND SAFETY

Includes passenger and cargo air transport operations; aircraft ground operations; flight safety and hazards; and aircraft accidents. Systems and hardware specific to ground operations of aircraft and to airport construction are covered in 09 Research and Support Facilities (Air). Air traffic control is covered in 04 Aircraft Communications and Navigation.

20000020783 Naval Postgraduate School, Monterey, CA USA
Aircraft Survivability 1999. Challenges for the New Millennium
Nov. 18, 1999; 45p; In English
Report No.(s): AD-A371753; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This paper presents abstracts on Aircraft Survivability in 1999. Some of the topics include: 1) CM (Countermeasures) What Works, What Doesn't; 2) Defeating The Threat At Low Altitude; 3) Spacecraft-A New Frontier for Aerospace Survivability; 4) U.S. Marine Corps Requirements For Aircrfaft Survivability; 5) MANPADS: The Vulnerability Challenge. This paper also includes poster abstracts.
CASI
Abstracts; Aircraft Survivability

20000020962 Massachusetts Inst. of Tech., Lincoln Lab., Cambridge, MA USA
Lincoln Laboratory Evaluation of TCAS II Logic, Volume 1, 7
Chludzinski, B. J.; Dec. 13, 1999; 88p; In English
Report No.(s): PB2000-102388; ATC-268-V1; No Copyright; Avail: Issuing Activity

This report documents the Lincoln Laboratory evaluation of the Traffic Alert and Collision Avoidance System II (TCAS II) logic version 7. TCAS II is an airbone collision avoidance system required since 30 December 1993 by the FAA on all air carrier aircraft with more than 30 passenger seats operating in the U.S. airspace. Version 7 is a major revision to the TCAS II logic consisting of more than 300 separately defined changes affecting all major TCAS areas (surveillance, CAS logic and displays/aurals). Lincoln Laboratory evaluated the logic by examining approximately two million simulated pairwise TCAS-TCAS encounters, derived from actual tracks recorded in U.S. airspace. The main goals of the evaluation were: (1) to study the performance of the new TCAS-TCAS coordinated reveral logic; (2) to detect and explain any areas of poor performance; (3) to examine the performance of the version 7 logic for the 30 Representative NMACs identified during the 6.04a logic evaluation; and (4) to understand the limitations of the logic by analyzing every version 7 NMAC.
NTIS
Aircraft Instruments; Flight Paths; Software Engineering; Collision Avoidance; Warning Systems

20000020963 Massachusetts Inst. of Tech., Lincoln Lab., Cambridge, MA USA
Lincoln Laboratory Evaluation of TCAS II Logic, Volume 2, Appendices, 7
Chludzinski, B. J.; Dec. 13, 1999; 320p; In English
Report No.(s): PB2000-102389; ATC-268-V2; No Copyright; Avail: Issuing Activity

This volume presents tables and figures that were generated during the assessment to the TCAS Logic Performance.
NTIS
Aircraft Instruments; Flight Paths; Logic

20000021144 Air Force Inst. of Tech., Wright-Patterson AFB, OH USA
Operational Risk Management and Military Aviation Safety
Ashley, Park D.; Sep. 1999; 101p; In English
Report No.(s): AD-A369672; AFIT/GLM/LAL/99S-2; No Copyright; Avail: CASI; A02, Microfiche; A06, Hardcopy

The Air Force Class A aviation mishap rate has hovered around 1.5 mishaps per 100,000 flight hours since 1985. Recent attention on Air Force accidents has caused the leadership to seek to reduce its mishap rate. The Army's Class A aviation mishap

rate declined after it implemented risk management (RM) principles in 1987. This reduction caught the attention of Air Force leadership who have since stated that the application of operational risk management (ORM) is how the Air Force will reduce, even eliminate, mishaps. With current budget constraints, ORM is considered to be the most cost-effective way the Air Force can reduce its mishap rate. The purpose of this research was to determine whether the Air Force can expect its mishap rate to significantly decline due to ORM implementation. This determination is based on the relationship between the Army's implementation of RM and its aviation mishap rate. The analysis of the Army's aviation mishap rates and available causal data was performed primarily using discontinuous piecewise linear regression. Results showed that the effect of RM was not reflected in the Army's mishap rates. As a result, the Air Force should not expect its mishap rate to significantly decline due to ORM implementation.
DTIC
Risk; Flight Safety; Aircraft Safety

20000021392 Alabama Univ., Dept. of Aerospace Engineering and Mechanics, Tuscaloosa, AL USA
In-Flight Advisor, Phase 1 *Final Report*
Bass, E.; Gainer, C.; Katz, A.; McInerny, S.; Merritt, W. T.; Dec. 1999; 92p; In English
Report No.(s): PB2000-102393; DOT/FAA/AR-99/67; No Copyright; Avail: CASI; A01, Microfiche; A05, Hardcopy

This report is the result of a feasibility study to assess the use of artificial intelligence (AI) in altering the crew of potential emergency situations before they actually occur. The objectives of the project are to specifically determine the feasibility of applying AI methodologies to reduce information overload on the pilot, to monitor data from selected components of an aircraft in flight, to inform the pilot of potentially critical events occurring or materializing, and to advise the pilot of specific actions to be taken in order to avoid potential mishaps.
NTIS
Artificial Intelligence; Flight Instruments; In-Flight Monitoring

20000021419 Federal Aviation Administration, Office of Aviation Research, Washington, DC USA
Engine Debris Penetration Testing *Final Report*
Nov. 1999; 154p; In English
Report No.(s): AD-A372688; DOT/FAA/AR-99/19; No Copyright; Avail: CASI; A08, Hardcopy; A02, Microfiche

The damaging effects from an uncontained aircraft turbine engine failure can be catastrophic. As a result, the Federal Aviation Administration (FAA) has commissioned a program to mitigate the damaging effects of such an event. The Uncontained Engine Debris Mitigation Program will involve both industry and government to determine possible engineering solutions to this problem. As part of this program, the Naval Air Warfare Center Weapons Division (NAWCWPNS) has been tasked to evaluate ballistic damage analysis tools and techniques that are currently in use by the defense community. The intent is to determine their applicability in predicting the damaging effects from an uncontained engine failure. This report documents testing that was conducted and the evaluation of several empirical penetration equations under the circumstances present during engine failure events. The data generated under this effort showed that variations in the velocity, orientation, and shape of the debris results in differing failure modes of the targets. When plugging failures of the targets occur, the results of the defense equations are quite good. When petaling failures occur the prediction accuracy was degraded. This resulted in the development of an FAA Energy Equation through numerical curve-fitting of the test data for 2024 T3 aluminum targets. Additional testing is planned to evaluate the penetration equations performance with real aircraft structure and varying obliquity angles at impact under phase II testing.
DTIC
Damage Assessment; Gas Turbine Engines; Aircraft Engines; Aircraft Accidents

20000021425 SRI International Corp., Menlo Park, CA USA
Full-Scale Tests of Lightweight Fragment Barriers on Commercial Aircraft *Final Report, 30 Dec. 1998-30 Jun. 1999*
Shockey, Donald A.; Erlich, David C.; Simons, Jeffrey W.; Nov. 1999; 14p; In English
Report No.(s): AD-A372648; DOT/FAA/AR-99/71; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Because fragments from inflight engine failures can damage critical aircraft components and produce catastrophic consequences, the Federal Aviation Administration is sponsoring research to mitigate the effects of uncontained engine bursts. SRI International is evaluating the ballistic effectiveness of fabric structures made from advanced polymers and developing a computational ability to design fragment barriers. In this reporting period, SRI performed full scale fabric barrier tests on an aircraft fuselage at the Navy Air Warfare Center in China Lake, CA. The tests examined the effects of polymer material, number of plies, location of the fabric within the fuselage wall, and gripping arrangements. The results were very encouraging. For example, three plies of polybenzoxazole (PBO) Zylon woven fabric glued to the outboard side of the insulation packet and

weighing only 0.05 g/sq cm (0.1 lb/sq ft) prevented a 166-g (0.37-lb) sharp edged fan blade fragment impacting edge-on at 230 m/s (756 ft/s) from penetrating into the cabin. The absorbed energy of 4400 joules (3250 ft-lb) is nearly an order of magnitude greater than that absorbed by the unfortified fuselage wall. The results confirmed that high strength polymer fabrics offer an extremely effective, low weight solution for mitigating the effects of uncontained turbine engine fragments on commercial aircraft.
DTIC
Full Scale Tests; Low Weight; Fragments; Commercial Aircraft; Impact Tests; Damage Assessment

20000021459 Aeronautical Radio, Inc., Annapolis, MD USA
Health Monitoring System Technology Assessments: Cost Benefits Analysis
Kent, Renee M., Aeronautical Radio, Inc., USA; Murphy, Dennis A., Aeronautical Radio, Inc., USA; January 2000; 171p; In English
Contract(s)/Grant(s): GS-35F-4825G; RTOP 728-30-10-02
Report No.(s): NASA/CR-2000-209848; NAS 1.26:209848; No Copyright; Avail: CASI; A08, Hardcopy; A02, Microfiche
The subject of sensor-based structural health monitoring is very diverse and encompasses a wide range of activities including initiatives and innovations involving the development of advanced sensor, signal processing, data analysis, and actuation and control technologies. In addition, it embraces the consideration of the availability of low-cost, high-quality contributing technologies, computational utilities, and hardware and software resources that enable the operational realization of robust health monitoring technologies. This report presents a detailed analysis of the cost benefit and other logistics and operational considerations associated with the implementation and utilization of sensor-based technologies for use in aerospace structure health monitoring. The scope of this volume is to assess the economic impact, from an end-user perspective, implementation health monitoring technologies on three structures. It specifically focuses on evaluating the impact on maintaining and supporting these structures with and without health monitoring capability.
Derived from text
Systems Health Monitoring; Cost Analysis; Aircraft Structures; Structural Analysis; Damage Assessment; Technology Assessment

20000021581 National Transportation Safety Board, Washington, DC USA
Evaluation of U.S. Department of Transportation Efforts in the 1990s to Address Operator Fatigue
May 1999; 109p; In English
Report No.(s): AD-A372555; NTSB/SR-99/01; No Copyright; Avail: Defense Technical Information Center (DTIC)
During the 1980s, the National Transportation Safety Board investigated several aviation, highway, and marine accidents that involved operator fatigue. Following completion of these accident investigations, the Safety Board in 1989 issued three recommendations to the U.S. Department of Transportation (DOT) addressing needed research, education, and revisions to hours-of-service regulations. Ten years have passed since these safety recommendations were issued. In the interim, the Safety Board has issued more than 70 additional recommendations to the DOT, States, industry, and industry associations to reduce the incidence of fatigue-related accidents. In response to the three 1989 recommendations, the DOT and the modal administrations have, in general, acted and responded positively to the recommendations addressing research and education; little action, however, has occurred with respect to revising the hours-of-service regulations. Nevertheless, the Safety Board believes that support has grown in recent years to make substantive changes to these regulations. This report provides an update on the activities and efforts by the DOT and the modal administrations to address operator fatigue and, consequently, the progress that has been made in the past 10 years to implement the actions called for in the three intermodal recommendations and other fatigue-related recommendations. The report also provides some background information on current hours-of-service regulations, fatigue, and the effects of fatigue on transportation safety. As a result of this safety report, the National Transportation Safety Board issued new safety recommendations to the U.S. Department of Transportation, the Federal Aviation Administration, the Federal Highway Administration, the Federal Railroad Administration, the Research and Special Programs Administration, and the USA Coast Guard.
DTIC
Fatigue (Biology); Accident Investigation; Operator Performance; Transportation; Accidents

20000024843 Air Force Inst. of Tech., Wright-Patterson AFB, OH USA
Improving African Fuel Availability in Support of Humanitarian Relief Operations
Dye, Steven C.; Jun. 1999; 63p; In English
Report No.(s): AD-A372323; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

Airlift operations into Africa are fuel intensive due to the great distance from the US to the Africa as well as size of Africa itself. Poor fuel infrastructure in Africa makes airlift operations increasingly difficult. United States European Command requested this study to examine methods for meeting the fuel requirement for a humanitarian relief operation in Africa. The three methods include air refueling as was done in Operation SUPPORT HOPE, a new initiative from USA European Command, and Offshore Petroleum Distribution System. Operation SUPPORT HOPE, humanitarian relief of Rwandan refugees, is examined for two reasons. First, it is the model for the expected airlift for just such an operation. Second, Operation SUPPORT HOPE was considered a success, so the methods may be the best possible solution. United States European Command's initiative is to either store fuel or contract for guaranteed fuel delivery at several locations in Africa. The final method examined is using the Offshore Petroleum Distribution System (OPDS). The OPDS is a specially equipped tanker ship capable of mooring four miles from shore and pumping aircraft fuel to the shore. The paper examines each option in terms of operational considerations and cost.
DTIC
Aircraft Fuels; Aircraft Fuel Systems

20000024874 Massachusetts Inst. of Tech., Lincoln Lab., Lexington, MA USA
Lincoln Laboratory Evaluation of TCAS 2 Logic, Volume 2, Appendices, Version 7
Chludzinzki, Barbara J.; Dec. 13, 1999; 307p; In English
Report No.(s): AD-A372380; ATC-268-Vol-2; No Copyright; Avail: CASI; A14, Hardcopy; A03, Microfiche

Volume 1 described the analysis procedures and inputs. This volume presents tables and figures that were generated during the assessment to the TCAS (Traffic Alert and Collision Avoidance System) Logic Performance.
DTIC
Air Traffic Control; Civil Aviation; Collision Avoidance; Logic Programming

20000025001 Army Natick Development Center, MA USA
Passive Airbag Vent Control Valve Study *Final Report, Oct. 1996 - Dec. 1998*
Rosato, Nicholas P., Army Natick Development Center, USA; Dec. 1999; 82p; In English
Contract(s)/Grant(s): DA Proj. 1L1-62786\D283
Report No.(s): AD-A372164; NATICK-TR-00-010; No Copyright; Avail: CASI; A01, Microfiche; A05, Hardcopy

The U.S. Army currently uses paper honeycomb material to both dissipate the ground impact energy and to cushion parachute delivered airdropped payload from damage. This report documents exploring the use of pressurized airbags with passively controlled exhaust vents as a means to mitigate ground impact landing shock. The results of both computational and experimental research that examined the performance of passively controlled venting candidates are presented. The venting candidates studied consisted of two different linear spring check valve designs, a magnetostatic check valve design, along with two precision release blowout vents configured using a four pole magnetic valve seat design.
DTIC
Air Bag Restraint Devices; Impact; Control Valves; Venting; Mechanical Shock; Honeycomb Structures; Vents

20000025078 NASA Langley Research Center, Hampton, VA USA
An Initial Study of the Sensitivity of Aircraft Vortex Spacing System (AVOSS) Spacing Sensitivity to Weather and Configuration Input Parameters
Riddick, Stephen E., NASA Langley Research Center, USA; Hinton, David A., NASA Langley Research Center, USA; January 2000; 26p; In English
Contract(s)/Grant(s): RTOP 576-02-11-11
Report No.(s): NASA/TM-2000-209849; NAS 1.15:209849; L-17947; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A study has been performed on a computer code modeling an aircraft wake vortex spacing system during final approach. This code represents an initial engineering model of a system to calculate reduced approach separation criteria needed to increase airport productivity. This report evaluates model sensitivity toward various weather conditions (crosswind, crosswind variance, turbulent kinetic energy, and thermal gradient), code configurations (approach corridor option, and wake demise definition), and post-processing techniques (rounding of provided spacing values, and controller time variance).
Author
Aircraft Wakes; Aircraft Approach Spacing; Air Traffic Control; Weather; Vortex Advisory System; Computer Programs

20000025231 NASA, Washington, DC USA

Aerospace Safety Advisory Panel Annual Report for 1999 *Annual Report, 1999*

blomberg, Richard D., NASA, USA; February 2000; 140p; In English; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

This report covers the activities of the Aerospace Safety Advisory Panel (ASAP) for the calendar year 1999.This was a year of notable achievements and significant frustrations. Both the Space Shuttle and International Space Station (ISS) programs were delayed.The Space Shuttle prudently postponed launches after the occurrence of a wiring short during ascent of the STS-93 mission. The ISS construction schedule slipped as a result of the Space Shuttle delays and problems the Russians experienced in readying the Service Module and its launch vehicle. Each of these setbacks was dealt with in a constructive way. The STS-93 short circuit led to detailed wiring inspections and repairs on all four orbiters as well as analysis of other key subsystems for similar types of hidden damage. The ISS launch delays afforded time for further testing, training, development, and contingency planning. The safety consciousness of the NASA and contractor workforces, from hands-on labor to top management, continues high. Nevertheless, workforce issues remain among the most serious safety concerns of the Panel. Cutbacks and reorganizations over the past several years have resulted in problems related to workforce size, critical skills, and the extent of on-the-job experience. These problems have the potential to impact safety as the Space Shuttle launch rate increases to meet the demands of the ISS and its other customers. As with last year's report, these work- force-related issues were considered of sufficient import to place them first in the material that follows. Some of the same issues of concern for the Space Shuttle and ISS arose in a review of the launch vehicle for the Terra mission that the Panel was asked by NASA to undertake. Other areas the Panel was requested to assess included the readiness of the Inertial Upper Stage for the deployment of the Chandra X-ray Observatory and the possible safety impact of electromagnetic effects on the Space Shuttle. The findings and recommendations in this report do not highlight any major, immediate issues that might compromise the safe pursuit of the various NASA programs. They do, however, cover concerns that the Panel believes should be addressed in the interest of maintaining NASA's excellent safety record.The Panel is pleased to note that remedial efforts for some of the findings raised are underway. Given appropriate funding and cooperative efforts among the Administration, the Congress and the various contractors, the Panel is convinced that safety problems can be avoided or solved resulting in lower risk for NASA's human space and aeronautics programs. Section II of this report contains specific findings and recommendations generated by Panel activities during the calendar year 1999. Section III presents more detailed information in support of these findings and recommendations. A current roster of Panel members, consultants, and staff is included as Appendix A. Appendix B contains NASA's response to the findings and recommendations from the 1998 annual report. It has been augmented this year to include brief explanations of why the Panel classified the NASA response as " open,""continuing," or "closed." Appendix C lists the fact-finding activities of the Panel in 1999.

Author

Aerospace Safety; NASA Programs; Planning; Risk; Safety; Safety Factors; Spacecraft Launching; Safety Management

20000025347 Army Safety Center, Fort Rucker, AL USA

FLIGHTFAX: Army Aviation Risk-Management Information. Volume 27, Number 12. Improving Aviation Safety Performance

Dec. 1999; 12p; In English

Report No.(s): AD-A372187; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

As an Army we are involved in missions around the world and doing a lot of things without the experience base we once enjoyed. This lack of experience, continuous deployments, and not having the discipline to maintain and enforce standards are basic causes of accidental losses. Some of us wearing wings are not executing fundamental tasks, those taught to us in flight school, to standard. Analysis of major FY99 aviation accidents reveals that most of the accidents didn't happen at the time of impact or during the crash sequence; they really occurred much earlier with a breakdown in leadership, standards or discipline. In fact, FY99 produced Army aviation's worst safety performance since Desert Shield/Desert Storm. With 18 Class A aviation flight accidents and 20 fatalities, the upward trend in accidents that began in FY98 continued to climb. When leaders fail to enforce established standards, the natural result is accidents-and accidents cost. They cost lives, they cost time, and they cost equipment: a total cost of more than $ 139 million for aviation in FY99. The bottom line: soldiers are dying and we are destroying costly equipment at a rate that is unacceptable. Leaders who understand and accept responsibility will help solve this Army-wide problem. Effective leaders will make sure soldiers know what the standards are and will ensure the standards are enforced.

DTIC

Aircraft Accidents; Aircraft Safety; Flight Safety; Risk; Management Information Systems; Costs

20000025486 NASA Langley Research Center, Hampton, VA USA

Design of an Aircraft Vortex Spacing System for Airport Capacity Improvement

Hinton, David A., NASA Langley Research Center, USA; Charnock, James K., NASA Langley Research Center, USA; Bagwell, Donald R., NASA Langley Research Center, USA; [2000]; 19p; In English; 38th; 38th Aerospace Sciences Meeting, 10-13 Jan. 2000, Reno, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Report No.(s): AIAA Paper 2000-0622; Copyright Waived; Avail: CASI; A03, Hardcopy; A01, Microfiche

The National Aeronautics and Space Administration (NASA) is addressing airport capacity enhancements through the Terminal Area Productivity (TAP) program. Within TAP, the Reduced Spacing Operations element at the NASA Langley Research Center is developing an Aircraft VOrtex Spacing System (AVOSS). AVOSS will integrate the output of several systems to produce weather dependent, dynamic wake vortex spacing criteria. These systems provide current and predicted weather conditions, models of wake vortex transport and decay in these weather conditions, and real-time feedback of wake vortex behavior from sensors. The goal of the NASA program is to provide the research and development to demonstrate an engineering model AVOSS, in real-time operation, at a major airport. A wake vortex system test facility was established at the Dallas-Fort Worth International Airport (DFW) in 1997 and tested in 1998. Results from operation of the initial AVOSS system, plus advances in wake vortex prediction and near-term weather forecast models, "nowcast", have been integrated into a second-generation system. This AVOSS version is undergoing final checkout in preparation for a system demonstration in 2000. This paper describes the revised AVOSS system architecture, subsystem enhancements, and initial results with AVOSS version 2 from a deployment at DFW in the fall of 1999.

Author

Airports; Vortices; Air Transportation; Aircraft Approach Spacing

20000025553 Massachusetts Inst. of Tech., Lincoln Lab., Lexington, MA USA

Lincoln Laboratory Evaluation of TCAS 2 Logic, Volume 1, Version 7

Chludzinzki, Barbara J.; Dec. 13, 1999; 75p; In English

Report No.(s): AD-A372379; ATC-268-Vol-1; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

This report documents the Lincoln Laboratory evaluation of the Traffic Alert and Collision Avoidance System II (TCAS II) logic version 7. TCAS II is an airborne collision avoidance system required since 30 December 1993 by the FAA on all air carrier aircraft with more than 30 passenger seats operating in the U.S. airspace. Version 7 is a major revision to the TCAS II logic consisting of more than 300 separately defined changes affecting all major TCAS areas (surveillance, CAS logic and displays/aurals). Lincoln Laboratory evaluated the logic by examining approximately two million simulated pairwise TCAS-TCAS encounters, derived from actual tracks recorded in U.S. airspace. The main goals of the evaluation were: (1) to study the performance of the new TCAS-TCAS coordinated reversal logic; (2) to detect and explain any areas of poor performance; (3) to examine the performance of the version 7 logic for the 30 Representative NMACs identified during the 6.04a logic evaluation; and (4) to understand the limitations of the logic by analyzing every version 7 NMAC. Five Lincoln Laboratory analysis programs written for previous logic evaluation work were updated and new software was written to aid in the evaluation of TCAS-TCAS sense reversals. There were four phases of the evaluation corresponding to the above goals. For each phase the report gives an overview of the evaluation approach taken and a description of the results. An overall summary and perspective on the evolution of the TCAS II logic are given at the end of the report.

DTIC

Collision Avoidance; Air Traffic Control; Airspace; Warning Systems; Accident Prevention; Civil Aviation

20000025778 National Aerospace Lab., Tokyo Japan

Simulation Tool for Analysing Crew Behavior. Part 1. Actions and Procedural Tasks

Muraoka, K.; Jun. 1999; 20p; In Japanese; Original contains color illustrations

Report No.(s): PB2000-102566; NAL-TR-1386; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This paper deals with an attempt to develop a crew behavioral model in an automated cockpit for use as an analytical engineering tool for issues including flight crew human factors. The model enables simulation of both physical and cognitive characteristics of human pilots. For the initial phase of development, a crew behavioral model with the ability to simulate actions and perform normal procedures was constructed in addition to the operational environment structure. The model was applied to reconstruction of an accident and simulation of an approach flight under normal procedures. Simulation results demonstrated that the model is able to provide a sequence of pilot behavior as a three-dimensional animation, with additional information such as

cockpit verbal communication and flight status, in addition to the feasibility of the tool providing analysis of flight crew human factors.
NTIS
Flight Crews; Human Factors Engineering; Human-Computer Interface; Cockpit Simulators; Simulation

20000025798 Alabama Univ., Dept. of Aerospace Engineering and Mechanics, Tuscaloosa, AL USA
In-Flight Advisor, Phase 1 *Final Report*
Bass, Ellen, Alabama Univ., USA; Gainer, CHarles, Alabama Univ., USA; Katz, Ammon, Alabama Univ., USA; McInerny, Sally, Alabama Univ., USA; Merritt, Wayne T., Alabama Univ., USA; Dec. 1999; 82p; In English
Report No.(s): AD-A372523; DOT/FAA/AR-99/67; No Copyright; Avail: CASI; A01, Microfiche; A05, Hardcopy
This report is the result of a feasibility study to assess the use of artificial intelligence (AI) in alerting the crew of potential emergency situations before they actually occur. The objectives of the project are to specifically determine the feasibility of applying AI methodologies to reduce information overload on the pilot, to monitor data from selected components of an aircraft in flight, to inform the pilot of potentially critical events occurring or materializing, and to advise the pilot of specific actions to be taken in order to delay or avoid potential mishaps.
DTIC
Artificial Intelligence; Expert Systems; Pilot Support Systems; In-Flight Monitoring

20000026820 National Transportation Safety Board, Washington, DC USA
National Transportation Safety Board Transportation Initial Decisions and Orders and Board Opinions and Orders Adopted and Issued during the Month of November 1999
Nov. 1999; 278p
Report No.(s): PB99-916711; NTSB/IDBOO-99/11; No Copyright; Avail: CASI; A13, Hardcopy; A03, Microfiche
This publication contains all Judge Initial Decisions and Board and Board Opinions and Orders in Safety and Seaman Enforcement Cases for November 1999.
NTIS
Air Transportation; Accident Prevention; Safety Management

20000026843 Civil Aeromedical Inst., Civil Aeromedical Inst., Oklahoma City, OK USA
Prevalence of Chlorpheniramine in Aviation Accident Pilot Fatalities, 1991-1996
Soper, John W., Civil Aeromedical Inst., USA; Chaturvedi, Arvind K., Civil Aeromedical Inst., USA; Canfield, Dennis V., Civil Aeromedical Inst., USA; Dec. 1999; 8p; In English
Contract(s)/Grant(s): AM-B-97-TOX-202
Report No.(s): AD-A372538; DOT/FAA/AM-99/29; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche
Chlorpheniramine, a popular nonprescription antihistaminic, is known to cause drowsiness. This side effect has a potential to impair performance and to be a factor in accidents. Therefore, this study was conducted to establish the prevalence of this drug in pilot fatalities of aviation accidents. During fatal aircraft accident investigations, postmortem samples collected from the pilots at autopsy are submitted to the Civil Aeromedical Institute for toxicological evaluation, and the findings are maintained in a database. Those data were examined for the presence of chlorpheniramine in the fatalities, which occurred during a 6-year (1991-1996) period. It was determined that there were 47 (2.2%) accidents involving chlorpheniramine. In 16 of these cases, only chlorpheniramine was found, with the mean concentrations of 109 ngml (n = 4) in blood and 1412 ng/g (n = 12) in liver. Other drugs were also present in the remaining 31 cases, wherein the mean chlorpheniramine concentrations were 93 ng/ml (n = 18) in blood and 747 ng/g (n = 12) in liver. Ninety-five percent of all the quantitative blood values were at or above the therapeutic (10 ng/ml) level, giving a 100 ng/ml (n = 21) blood mean level. The drug's mean concentration in the liver of all the cases was 1080 ng/g (n = 24). The average chlorpheniramine blood value was approximately 10 times higher than its therapeutic value. The presence of other drugs did not appear to significantly alter the blood level of chlorpheniramine, but no such correlation could be established with the hepatic value. The approximate 10-fold increase in the liver concentration, as compared with the blood value, was consistent with the general trend of the distribution of drugs in the hepatic compartment. However, the contribution of postmortem redistribution of the drug to alter its concentration cannot be entirely ruled out.
DTIC
Aerospace Medicine; Aircraft Accidents; Pharmacology; Toxicology; Aircraft Pilots

20000026844 National Transportation Safety Board, Washington, DC USA
Safety Recommendation
Jul. 13, 1999; 5p; In English
Report No.(s): AD-A372568; No Copyright; Avail: CASI; A01, Microfiche; A01, Hardcopy

On October 15, 1998, Delta Air Lines flight 915, a McDonnell Douglas MD-88, N902DE, experienced an uncontained failure in the No. 2 (right) engine, a Pratt & Whitney (P&W) JT8D-219, immediately after takeoff from Logan International Airport, Boston, Massachusetts. The pilots reported that, just after takeoff they felt a light thump, the airplane yawed to the right, and the cockpit instrumentation indicated that the No. 2 engine had lost power. The pilots then declared an emergency and returned to Boston. None of the 128 passengers, 4 flight attendants, and 2 pilots on board were injured. The airplane was operating on an instrument flight rules flight plan under the provisions of 14 Code of Federal Regulations Part 121 as a regularly scheduled passenger flight from Boston to Atlanta, Georgia.
DTIC
Aircraft Accident Investigation; Instrument Flight Rules; Failure; Flight Safety; Commercial Aircraft

20000026845 National Transportation Safety Board, Washington, DC USA
Safety Recommendation
Hall, Jim, National Transportation Safety Board, USA; Sep. 09, 1999; 4p; In English
Report No.(s): AD-A372583; No Copyright; Avail: CASI; A01, Microfiche; A01, Hardcopy

On February 6, 1999, at 0336 central standard time, Federal Express flight 1020 (FDX1020), a McDonnell-Douglas DC-10F, and Air Canada flight 754 (ACA754), an Airbus A320, were involved in a near midair collision approximately 40 miles north of Lincoln, Nebraska. While ACA754 was in cruise at flight level 350 (approximately 35,000 feet above sea level), the pilot received a Traffic Alert and Collision Avoidance System (TCAS)1 traffic advisory (TA) about FDX1020 then a resolution advisory (RA), directing the flight crew to climb to avoid a potential collision. The two aircraft subsequently passed within one mile. horizontally and 600 feet vertically. FDX1020 was not equipped with TCAS nor was it required. The flight crew of FDXl020 reported that it had not received any TAs from air traffic control (ATC) and had not been notified that proper separation had not been maintained. Neither aircraft was damaged, and no injuries were reported. Visual meteorological conditions (VMC) prevailed at the time of the incident. Both flights were operating under 14 Code of Federal Regulations (CFR) Part 121 on instrument flight plans.
DTIC
Aircraft Accidents; Collision Avoidance; Midair Collisions; Flight Safety; Accident Prevention; Aircraft Hazards

20000026847 National Transportation Safety Board, Washington, DC USA
Safety Recommendation
Jun. 01, 1999; 13p; In English
Report No.(s): AD-A372586; No Copyright; Avail: CASI; A01, Microfiche; A03, Hardcopy

During the 1980s, the National Transportation Safety Board investigated several accidents that involved operator fatigue. Following completion of these accident investigations, the Safety Board in 1989 issued three recommendations to the U.S. Department of Transportation (DOT): Expedite a coordinated research program on the effects of fatigue, sleepiness, sleep disorders, and circadian factors on transportation system safety, (I-89-1). Develop and disseminate educational material for transportation industry personnel and management regarding shift work; work and rest schedules; and proper regimens of health, diet, and rest, (I-89-2). Review and upgrade regulations governing hours of service for all transportation modes to assure that they are consistent and that they incorporate the results of the latest research on fatigue and sleep issues (I-89-3).
DTIC
Accident Investigation; Circadian Rhythms; Transportation; Sleep; Operators (Personnel)

20000026848 National Transportation Safety Board, Washington, DC USA
Safety Recommendation
Jun. 01, 1999; 12p; In English
Report No.(s): AD-A372587; No Copyright; Avail: CASI; A01, Microfiche; A03, Hardcopy

During the 1980s, the National Transportation Safety Board investigated several accidents that involved operator fatigue. Following completion of these accident investigations, the Safety Board in 1989 issued three recommendations to the U.S. Department of Transportation (DOT): Expedite a coordinated research program on the effects of fatigue, sleepiness, sleep disorders, and circadian factors on transportation system safety, (I-89-1). Develop and disseminate educational material for transportation industry personnel and management regarding shift work; work and rest schedules; and proper regimens of health,

diet, and rest, (I-89-2). Review and upgrade regulations governing hours of service for all transportation modes to assure that they are consistent and that they incorporate the results of the latest research on fatigue and sleep issues (I-89-3).
DTIC
Accident Investigation; Circadian Rhythms; Transportation; Sleep; Operators (Personnel)

20000026849 National Transportation Safety Board, Washington, DC USA
Safety Recommendation
Hall, Jim, National Transportation Safety Board, USA; Jun. 08, 1999; 3p; In English
Report No.(s): AD-A372595; NTSB-A-99-46; No Copyright; Avail: CASI; A01, Microfiche; A01, Hardcopy

The Safety Board is concerned about the lack of conspicuity of primary targets in ARTS systems. The Board concludes that increasing primary targets' visibility to controllers is essential to enhancing flight safety. Modify all variants of Automatic Radar Tracking System software to automatically track primary radar targets that have characteristics consistent with aircraft in flight and tag them with a persistent track symbol that will be continuously displayed to controllers. Further, this feature should be incorporated into all future Federal Aviation Administration terminal radar data processing systems. (A-9946)
DTIC
Flight Safety; Aircraft Accidents; Aircraft Accident Investigation; Collision Avoidance; Safety Management

20000026850 National Transportation Safety Board, Washington, DC USA
Safety Recommendation
Hall, Jim, National Transportation Safety Board, USA; May 28, 1999; 5p; In English
Report No.(s): AD-A372611; NTSB-A-99-47,THROUGH,50; No Copyright; Avail: CASI; A01, Microfiche; A01, Hardcopy

This report explains the accident involving a Beech T-35A, N140SW colliding with the ground near Rydall, Georgia, following an inflight separation of the right wing.
DTIC
Aircraft Accidents; Aircraft Accident Investigation; Collision Avoidance

04
AIRCRAFT COMMUNICATIONS AND NAVIGATION

Includes all modes of communication with and between aircraft; air navigation systems (satellite and ground based); and air traffic control.

20000021153 Department of Defense, Office of Inspector General, Arlington, VA USA
Preparation of the Global Positioning System for Year 2000
Aug. 09, 1999; 29p; In English
Contract(s)/Grant(s): Proj. 8AL-0041.05
Report No.(s): AD-A366989; IG/DOD-99-229; No Copyright; Avail: CASI; A01, Microfiche; A03, Hardcopy

The audit objective was to determine whether planning and management are adequate to ensure that the Global Positioning System will continue to operate effectively in the year 2000. The Global Positioning System consists of an Operational Control Segment, a Space Segment, and a User Segment. Specifically, we audited the Operational Control and the Space Segments. The year 2000 compliance status of the User Segment was addressed in Inspector General, DoD, Report No. 99-063. (See Appendix A, Summary of Prior Coverage.) Because the Global Positioning System has a unique internal time system designated as "Global Positioning System Time," we also determined whether the Global Positioning System Time would operate effectively after the End-of-Week rollover on August 21, 1999.
DTIC
Global Positioning System; Computer Information Security; Software Reliability

20000024848 Pennsylvania State Univ., Dept. of Computer Science and Engineering, University Park, PA USA
Performance Characterization of Obstacle Detection Algorithms for Aircraft Navigation *Final Report, 1 Aug. 1997 - 31 Dec. 1999*
Kasturi, Rangachar, Pennsylvania State Univ., USA; Camps, Octavia, Pennsylvania State Univ., USA; Coraor, Lee, Pennsylvania State Univ., USA; Gandhi, Tarak, Pennsylvania State Univ., USA; Hartman, Kerry, Pennsylvania State Univ., USA; Yang, Mau–Tsuen, Pennsylvania State Univ., USA; Jan. 28, 2000; 3p; In English
Contract(s)/Grant(s): NAG2-1152

Report No.(s): CSE-00-002; No Copyright; Avail: Issuing Activity; Abstract Only

The research reported here is a part of NASA's Synthetic Vision System (SVS) project for the development of a High Speed Civil Transport Aircraft (HSCT). One of the components of the SVS is a module for detection of potential obstacles in the aircraft's flight path by analyzing the images captured by an on-board camera in real-time. Design of such a module includes the selection and characterization of robust, reliable, and fast techniques and their implementation for execution in real-time. This report describes the results of our research in realizing such a design.

Author

Air Navigation; Flight Paths; Aircraft Instruments; Flight Safety; Flight Hazards; Collision Avoidance; Image Processing; Image Analysis; Algorithms

20000025044 Technion Research and Development Foundation Ltd., Haifa, Israel

A Cognitive Game Theoretic Analysis of Conflict Alerts in Air Traffic Control *Final Report, 15 May 1997 - 7 Nov. 1999*

Erev, Ido, Technion Research and Development Foundation Ltd., Israel; Gopher, Daniel, Technion Research and Development Foundation Ltd., Israel; Remington, Roger, Technion Research and Development Foundation Ltd., Israel; [1999]; 6p; In English

Contract(s)/Grant(s): NCC2-995

Report No.(s): Rept-197-309; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

The current research was motivated by a joint Government/Industry committee to introduce a new traffic control system, referred to as the Free Flight. This system is designed to use recent new technology to facilitate efficient and safe air transportation. We addressed one of the major difficulties that arise in the design of this and similar multi-agent systems: the adaptive (and slippery) nature of human agents. To facilitate a safe and efficient design of this multi-agent system, designers have to rely on assessments of the expected behavior of the different agents under various scenarios. Whereas the behavior of the computerized agents is predictable, the behavior of the human agents (including air traffic controllers and pilots) is not. Experimental and empirical observations suggest that human agents are likely to adjust their behavior to the design of the system. to see the difficulty that the adaptive nature of human agents creates assume that a good approximation of the way operators currently behave is available. Given this information an optimal design can be performed. The problem arises as the human operator will learn to adjust their behavior to the new system. Following this adjustment process the assumptions made by the designer concerning the operators behavior will no longer be accurate and the system might reach a suboptimal state. In extreme situations these potential suboptimal states might involve unnecessary risk. That is, the fact that operators learn in an adaptive fashion does not imply that the system will become safer as they gain experience. At least in the context of Safety dilemmas, experience can lead to a pareto deficient risk taking behavior.

Author

Air Traffic Control; Air Traffic Controllers (Personnel); Psychological Factors; Aviation Psychology; Human Factors Engineering

20000025198 Oklahoma Univ., Norman, OK USA

Reduced Posting and Marking of Flight Progress Strips for En Route Air Traffic Control *Final Report*

Truitt, Todd R., Oklahoma Univ., USA; Durso, Francis T., Oklahoma Univ., USA; Crutchfield, Jerry, Oklahoma Univ., USA; Moertl, Peter, Oklahoma Univ., USA; Manning, Carol A., Civil Aeromedical Inst., USA; February 2000; 46p; In English

Contract(s)/Grant(s): FAA-96-G-040

Report No.(s): DOT/FAA/AM-00/5; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The new Display System Replacement (DSR) being implemented in air route traffic control centers (ARTCCS) will allow the data-side controller less room to post Flight Progress Strips (FPSs). We tested a new FPS marking and posting procedure designed to reduce the controller's need for, or reliance on, the FPS. The experiment was conducted at Cleveland (ZOB) and Jacksonville (ZJX) ARTCCs utilizing individual controllers and controller teams operating in either high- or low-altitude sectors. Each controller ran two, 30-minute scenarios. Scenarios were counterbalanced, but sample sizes did not allow counterbalancing of conditions. In the Normal scenario, controllers worked as they normally would. During the Experimental scenario, controllers were asked to remove FPSs that were not needed after radar contact and communications were established. Also, FPS marking was not required for any information that was recorded elsewhere, such as via computer entry or landline communication. Controllers responded to the Workload Assessment Keypad (WAK) every 5 minutes while a subject matter expert made performance ratings. Experimenters recorded activity relevant to the plan view display, computer readout device, and FPSS. At the end of each scenario, controllers provided a position relief briefing and completed a modified version of the NASA Task Load Index. For individuals and teams at ZOB and ZJX, results showed that controllers posted fewer FPSs and marked them less often in the experimental procedure. No detrimental effects on performance, workload, position relief briefings, or team

communications were observed. On-line measures of workload (i.e., the WAK) were comparable and sometimes lower for the experimental condition. Most controllers reported that they preferred the experimental procedure.
Author
Air Traffic Control; Workloads (Psychophysiology); Performance Tests; Aircraft Guidance; Flight Control

20000025493 Federal Aviation Administration, William J. Hughes Technical Center, Atlantic City, NJ USA
Terminal Air Traffic Control Radar and Display System Recommendations for Monitoring Simultaneous Instrument Approaches
Morrow–Magyrits, Sherri; Ozmore, Richard; Dec. 1999; 30p; In English
Report No.(s): AD-A372400; ACT-540; DOT/FAA/CT-TN99/24; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The Multiple Parallel Approach Program (MPAP), under the auspices of the FAA Secondary Surveillance Integrated Product Team, AND-450, was developed to evaluate the feasibility of conducting simultaneous parallel approaches using both current and advanced radar and display system technology. The program focused primarily on the capacity-enhancing benefits of a Precision Runway Monitor system with various airport configurations. MPAP conducted over 20 real-time, human-in-the-loop and fast-time modeling simulations since 1988. The purpose of these simulations was to develop procedures for independent approaches to quadruple, triple, and closely spaced dual parallel runways in instrument meteorological conditions. This report provides a history of all MPAP simulations conducted to date, including a description of the test criteria used to evaluate each test, the findings, and subsequent procedural and equipment recommendations.
DTIC
Air Traffic Control; Computerized Simulation; Instrument Approach; Display Devices

20000025768 Civil Aeromedical Inst., Oklahoma City, OK USA
Comparing Text and Graphics in Navigation Display Design *Final Report*
Williams, Kevin W., Civil Aeromedical Inst., USA; February 2000; 18p; In English
Contract(s)/Grant(s): AM-A-HRR-519-99
Report No.(s): DOT/FAA/AM-00/8; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Thirty-six pilots were tested in a flight simulator on their ability to decide which of two airports was farther from a storm front, based on the manner in which information was presented on a navigational display. The results support the superiority of graphical over textual information display of nearest airport information. Pilots were significantly faster using the map display than using either the text-only display or the enhanced-text display. In addition, in contrast to an earlier study (Williams, 1999), pilots performed better using a north-up map than when using a track-up map. Discussion of the results focuses on recommendations for moving-map displays and the display requirements for support of the nearest-airport function within a navigational display.
Author
Navigation Aids; Display Devices; Air Navigation; Human-Computer Interface; Pilot Performance

05
AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes all stages of design of aircraft and aircraft structures and systems. Also includes aircraft testing, performance, and evaluation, and aircraft and flight simulation technology.

20000021013 Department of Defense, Office of Inspector General, Arlington, VA USA
C-17 Program Serialization of Airframe Fracture-Critical and Landing-Gear Reliability-Critical Parts
Mar. 24, 1999; 26p; In English
Contract(s)/Grant(s): Proj. 8AL-3002.00
Report No.(s): AD-A367044; IG/DOD-99-114; No Copyright; Avail: CASI; A01, Microfiche; A03, Hardcopy

This report is the first in a series on the life-cycle management of military aircraft landing-gear parts. This report addresses the serialization and tracking of airframe fracture-critical and landing-gear reliability-critical parts for the C-17 aircraft. The audit objective was to evaluate the Air Force actions to serialize and provide part-tracking capability of C-17 airframe fracture-critical and landing-gear reliability-critical parts to facilitate life-cycle management. We also evaluated the effectiveness of the management control program as it applied to the audit objective.
DTIC
C-17 Aircraft; Airframes; Fracturing; Landing Gear; Structural Reliability

20000021152 Department of Defense, Office of Inspector General, Arlington, VA USA
Operational Testing and Evaluation of F/A-18E/F Super Hornet
Jul. 07, 1999; 40p; In English
Contract(s)/Grant(s): Proj. 9AE-0087
Report No.(s): AD-A366987; IG/DOD-99-205; No Copyright; Avail: CASI; A01, Microfiche; A03, Hardcopy

We conducted the audit in response to a request by the Honorable Russell D. Feingold, U.S. Senator from Wisconsin. The Senator was concerned about the quality of operational testing and evaluation provided in support of the F/A-18E/F Super Hornet program production decisions. He was also concerned that the Office of the Secretary of Defense might not have received timely information on the problem known as wing drop. The F/A-18E/F Super Hornet is a major model upgrade to the F/A-18 aircraft. It is a high-performance twin-engine, mid-wing multi-mission tactical aircraft designed to replace the F/A-18C/D Hornet, the A-6E Intruder, and the F-14 Tomcat aircraft. Our objective was to evaluate and monitor the process for planning, executing, and reporting operational test results in support of the third low-rate production decision made on January 29, 1999, and in preparing for the operational evaluation that began in May 1999, for the F/A-18E/F Super Hornet program. We also determined when F/A-18E/F Super Hornet program officials provided the Office of the Secretary of Defense with timely information on the wing drop problem.
DTIC
F-18 Aircraft; Wings; Performance Tests

20000021171 Princeton Univ., Dept. of Mechanical and Aerospace Engineering, NJ USA
Adding In-Plane Flexibility to the Equations of Motion of a Single Rotor Helicopter *Final Report, 1 Feb. 1989 - 31 Jan. 2000*
Curtiss, H. C., Jr., Princeton Univ., USA; Feb. 06, 2000; 25p; In English
Contract(s)/Grant(s): NAG2-561; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This report describes a way to add the effects of main rotor blade flexibility in the in- plane or lead-lag direction to a large set of non-linear equations of motion for a single rotor helicopter with rigid blades(l). Differences between the frequency of the regressing lag mode predicted by the equations of (1) and that measured in flight (2) for a UH-60 helicopter indicate that some element is missing from the analytical model of (1) which assumes rigid blades. A previous study (3) noted a similar discrepancy for the CH-53 helicopter. Using a relatively simple analytical model in (3), compared to (1), it was shown that a mechanical lag damper increases significantly the coupling between the rigid lag mode and the first flexible mode. This increased coupling due to a powerful lag damper produces an increase in the lowest lag frequency when viewed in a frame rotating with the blade. Flight test measurements normally indicate the frequency of this mode in a non-rotating or fixed frame. This report presents the additions necessary to the full equations of motion, to include main rotor blade lag flexibility. Since these additions are made to a very complex nonlinear dynamic model, in order to provide physical insight, a discussion of the results obtained from a simplified set of equations of motion is included. The reduced model illustrates the physics involved in the coupling and should indicate trends in the full model.
Derived from text
H-53 Helicopter; Rotor Blades (Turbomachinery); Rotary Wings

20000021266 Boeing Phantom Works, Seattle, WA USA
Demonstration of ATM-Based Advanced AWACS Network With Integrated Battlespace Simulation *Final Report, Aug. 1996 - Nov. 1998*
Kim, Jae H.; Thompson, Michael Y.; Ray, Sankar; Jul. 1999; 150p; In English
Contract(s)/Grant(s): F30602-96-C-0212; AF Proj. 4519
Report No.(s): AD-A368874; AFRL-IF-RS-TR-1999-157; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

Future C4I aircraft mission avionics suites will be required to handle a much greater aggregate data rate than is the case today, and also be required to provide a much more comprehensive set of network services to support on-board battle staffs. Current on-board networking technology cannot meet these emerging requirements. Asynchronous Transfer Mode (ATM) networking technology has been identified as a significant potential backbone network for future mission avionics. ATM technology has been successfully demonstrated for some military applications, such as for fixed ground-based fiber networks, and the extension of this technology into the RF medium is currently under way with field demonstrations expected to take place very soon. For potential applications to airborne C4I, an ATM local-area network had been successfully demonstrated on Casey 01, but the demonstration did not include an operational scenario nor was it configured with a realistic C4I aircraft avionics mite. Thus, while ATM undoubtedly shows significant potential to meet on-board C4I network requirements, ATM network applicability and cost effectiveness for realistic C4I aircraft applications has to be fully implemented, quantitatively assessed, and operationally

demonstrated. The objective of this program was to design, implement, assess, and demonstrate an ATM network in a realistic airborne C4I demonstration system (i.e., Advanced AWACS prototype).
DTIC
Asynchronous Transfer Mode; Military Technology; Computerized Simulation; Communication Networks

20000021279 General Accounting Office, National Security and International Affairs Div., Washington, DC USA
Defense Acquisitions: Progress in Meeting F-22 Cost and Schedule Goals
Dec. 07, 1999; 9p; In English; Testimony before the Committee on Government Reform, Subsommittee on National Security, Veterans Affairs, and International Relations, House of Representatives.
Report No.(s): AD-A371350; GAO/T-NSIAD-00-58; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

Thank you for the opportunity to submit this statement for the record. The Subcommittee requested that we provide information on the status of cost and schedule issues of the Air Force's F-22 aircraft development and procurement program.
DTIC
Fighter Aircraft; Aircraft Design

20000021390 Cherry (R. G. W.) and Associates Ltd., Hertford, UK
Benefit Analysis for Nitrogen Inerting of Aircraft Fuel Tanks against Ground Fire Explosion *Final Report*
Cherry, R.; Warren, K.; Dec. 1999; 126p; In English
Report No.(s): PB2000-102443; DOT/FAA/AR-99/73; No Copyright; Avail: CASI; A02, Microfiche; A07, Hardcopy

The objective of this analysis was to access the potential benefits, in terms of reducing fatalities and injuries, resulting from three methods of aircraft fuel tank inerting. The methods analyzed were ground nitrogen inerting in center fuel tank only, ground nitrogen inerting in all fuel tanks, and onboard nitrogen inerting in all fuel tanks. Thirteen accidents to transport category aircraft were identified during the period from 1966 to 1995 that may have involved a fuel tank explosion. A mathematical technique was used to model each accident scenario and a Monte Carlo simulation was used to assess a high, median, and low value for the total achievable benefits.
NTIS
Nitrogen; Fuel Tanks; Aircraft Fuels; Explosions; Fires

20000023179 Virginia Polytechnic Inst. and State Univ., Dept. of Aerospace and Ocean Engineering, Blacksburg, VA USA
Flexible Wing Model for Structural Sizing and Multidisciplinary Design Optimization of a Strut-Braced Wing
Gern, Frank H., Virginia Polytechnic Inst. and State Univ., USA; Naghshineh, Amir H., Virginia Polytechnic Inst. and State Univ., USA; Sulaeman, Erwin, Virginia Polytechnic Inst. and State Univ., USA; Kapania, Rakesh K., Virginia Polytechnic Inst. and State Univ., USA; Haftka, Raphael T., Florida Univ., USA; [2000]; 13p; In English; 41st; 41st Structures, Structural Dynamics and Materials Meeting, 3-6 Apr. 2000, Atlanta, GA, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Report No.(s): AIAA Paper 2000-1327; Copyright Waived; Avail: CASI; A03, Hardcopy; A01, Microfiche

This paper describes a structural and aeroelastic model for wing sizing and weight calculation of a strut-braced wing. The wing weight is calculated using a newly developed structural weight analysis module considering the special nature of strut-braced wings. A specially developed aeroelastic model enables one to consider wing flexibility and spanload redistribution during in-flight maneuvers. The structural model uses a hexagonal wing-box featuring skin panels, stringers, and spar caps, whereas the aerodynamics part employs a linearized transonic vortex lattice method. Thus, the wing weight may be calculated from the rigid or flexible wing spanload. The calculations reveal the significant influence of the strut on the bending material weight of the wing. The use of a strut enables one to design a wing with thin airfoils without weight penalty. The strut also influences wing spanload and deformations. Weight savings are not only possible by calculation and iterative resizing of the wing structure according to the actual design loads. Moreover, as an advantage over the cantilever wing, employment of the strut twist moment for further load alleviation leads to increased savings in structural weight.
Author
Multidisciplinary Design Optimization; Struts; Flexible Wings; Aircraft Design; Design Analysis; Structural Design

20000023189 NASA Langley Research Center, Hampton, VA USA
A Rapid Empirical Method for Estimating the Gross Takeoff Weight of a High Speed Civil Transport
Mack, Robert J., NASA Langley Research Center, USA; December 1999; 20p; In English
Contract(s)/Grant(s): RTOP 537-07-21
Report No.(s): NASA/TM-1999-209535; NAS 1.15:209535; L-17743; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

During the cruise segment of the flight mission, aircraft flying at supersonic speeds generate sonic booms that are usually maximum at the beginning of cruise. The pressure signature with the shocks causing these perceived booms can be predicted if the aircraft's geometry, Mach number, altitude, angle of attack, and cruise weight are known. Most methods for estimating aircraft weight, especially beginning-cruise weight, are empirical and based on least- square-fit equations that best represent a body of component weight data. The empirical method discussed in this report used simplified weight equations based on a study of performance and weight data from conceptual and real transport aircraft. Like other weight-estimation methods, weights were determined at several points in the mission. While these additional weights were found to be useful, it is the determination of beginning-cruise weight that is most important for the prediction of the aircraft's sonic-boom characteristics.
Author
Takeoff; Structural Weight

20000023217 NASA Ames Research Center, Moffett Field, CA USA
Future Civil Aircraft and Technologies
Albers, J., NASA Ames Research Center, USA; Zuk, J., NASA Ames Research Center, USA; SAE Transactions; 1989; In English
Report No.(s): SAE-1989-1642; Copyright; Avail: Issuing Activity, Hardcopy

New aircraft technologies are presented that have the potential to expand the air transportation system and reduce congestion through new operating capabilities while also providing greater levels of safety and environmental compatibility. These new capabilities will result from current and planned civil aeronautics technology at the NASA Ames, Lewis, and Langley Research Centers and will cover the complete spectrum of current aircraft and new vehicle concepts including rotorcraft (helicopters and tilt rotors), vertical and short takeoff and landing (V/STOL), and short takeoff and landing (STOL) aircraft, subsonic transports, high-speed transports, and hypersonic/transatmospheric vehicles. New technologies will improve efficiency, affordability, safety, and environmental compatibility of current aircraft and will enable the development of new transportation system. The new capabilities of vehicles could lead to substantial market opportunities and economic growth and could improve the competitive position of the U.S. aerospace industry.
Author
Aeronautical Engineering; Aircraft Industry; Air Transportation; Transport Aircraft; Civil Aviation

20000023236 Virginia Polytechnic Inst. and State Univ., Aerospace and Ocean Engineering Dept., Blacksburg, VA USA
Multidisciplinary Design Optimization of a Strut-Braced Wing Transonic Transport
Gundlach, John F., IV, Virginia Polytechnic Inst. and State Univ., USA; Tetrault, Phillippe–Andre, Virginia Polytechnic Inst. and State Univ., USA; Gern, Frank, Virginia Polytechnic Inst. and State Univ., USA; Nagshineh–Pour–Amir, Virginia Polytechnic Inst. and State Univ., USA; Ko, Andy, Virginia Polytechnic Inst. and State Univ., USA; Schetz, Joseph, Virginia Polytechnic Inst. and State Univ., USA; Mason, William, Virginia Polytechnic Inst. and State Univ., USA; Kapania, Rakesh, Virginia Polytechnic Inst. and State Univ., USA; Grossman, Bernard, Virginia Polytechnic Inst. and State Univ., USA; Haftka, Raphael T., Florida Univ., USA; [2000]; 14p; In English; 38th; 38th Aerospace Sciences Meeting, 10-13 Jan. 2000, Reno, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Report No.(s): AIAA Paper 2000-0420; Copyright Waived; Avail: CASI; A03, Hardcopy; A01, Microfiche

Recent transonic airliner designs have generally converged upon a common cantilever low-wing configuration. It is unlikely that further large strides in performance are possible without a significant departure from the present design paradigm. One such alternative configuration is the strut-braced wing, which uses a strut for wing bending load alleviation, allowing increased aspect ratio and reduced wing thickness to increase the lift to drag ratio. The thinner wing has less transonic wave drag, permitting the wing to unsweep for increased areas of natural laminar flow and further structural weight savings. High aerodynamic efficiency translates into smaller, quieter, less expensive engines with lower noise pollution. A Multidisciplinary Design Optimization (MDO) approach is essential to understand the full potential of this synergistic configuration due to the strong interdependency of structures, aerodynamics and propulsion. NASA defined a need for a 325-passenger transport capable of flying 7500 nautical miles at Mach 0.85 for a 2010 service entry date. Lockheed Martin Aeronautical Systems (LMAS), as Virginia Tech's industry partner, placed great emphasis on realistic constraints, projected technology levels, manufacturing and certification issues. Numerous design challenges specific to the strut-braced wing became apparent through the interactions with LMAS.
Author
Multidisciplinary Design Optimization; Struts; Aircraft Design; Design Analysis; Wings

20000024808 Air Force Materiel Command, Wright-Patterson AFB, OH USA
Flight Test Theory Applied to Aircraft Modifications
Alford, Lionel D., Jr., Air Force Materiel Command, USA; Knarr, Robert C., Knarr (Robert), USA; Cockpit; Oct., Nov., Dec.

1999; ISSN 0742-1508, pp. 6-13; In English; Copyright; Avail: Issuing Activity

A new design aircraft program always conducts an instrumented test to validate the analyses. A modification program, on the other hand, may rely on previously collected data for model validation. It is imperative that a modification program adequately demonstrate the effects of the modification on the aircraft and its mission. The user must judge these effects for their desirability especially when they degrade mission capability. But, to be judged, they must be fully understood. Historical data and/or test must be used to validate the data by which these effects on aircraft capability are judged. In this article, we address critical Test & Evaluation consideration for an external aircraft modification. In each case, we define the subject area and explain its importance to the C-130 by discussing the Rationale behind the standard design practices and Air Worthiness & Operational Consideration for the fleet aircraft. We will also give concrete examples of each case. Although only effects to the C-130 aircraft are discussed in detail, these principles and observations apply to any aircraft.

Author

Aircraft Design; C-130 Aircraft; Flight Tests; Structural Design; Aircraft Reliability; Aircraft Performance

20000024877 Defence and Civil Inst. of Environmental Medicine, Toronto, Ontario Canada

Evaluation of NDT Technologies in Support of CP 140 Aircraft Sampling Inspection

Giguere, J. S.; Oct. 1999; 21p; In English

Report No.(s): AD-A372449; DCIEM-TM-1999-116; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This evaluation was undertaken to identify possible nondestructive inspection systems that will fulfill the requirements of the CP140 Aircraft Structural Integrity Programme (ASIP). The CP140 aircraft is fast approaching its originally intended life expectancy and staff from the Directorate of Technical Airworthiness and the CP140 Aircraft Engineering Office are considering an extension. In that light, the third line support contractor (i.e., Industrial Maritime Products (I.M.P.) Group Limited) has identified critical areas via the Reliability Centered Maintenance methodology. More specifically, the Common characteristic of these areas is the fact that they are not inspected under the current maintenance plan. As a result, data is lacking for a proper assessment of the aircraft structure. Hence, I.M.P. Group Limited has devised a number of Shop Instruction Notes (SINs) for the inspection of these areas that will require the use of nondestructive inspection systems. The proposed SINs call for the inspection of large surfaces, which preclude the use of most nondestructive inspection systems on a cost and time constraint basis. However, two systems were perceived as fulfilling the inspection requirements. They are the Magneto-Optic Imager (MOI) by PRI Research and Development Corporation and the D-Sight Aircraft Inspection System (DAIS) by Laser Measurement International (LMI) Inc. Automotive Division Both of these systems could provide for quick inspection of large surfaces. The evaluation documented in this report provides some insight on the advantages and disadvantages associated with both systems. Eased on the evaluation results, the DAIS should enable the quick inspection of the overall aircraft structure and highlight areas with corrosion. However, this inspection systems will not cover all SINs requirements. This deficiency can only be addressed by the use of other inspections systems.

DTIC

Inspection; Aircraft Structures; Nondestructive Tests; Sampling; Aircraft Maintenance

20000024916 Air Force Inst. of Tech., Wright-Patterson AFB, OH USA

Reparable Inventory Reduction: Impacts on Air Force Fighter Aircraft Mission Capability

Hutson, Gregory E.; Sep. 1999; 297p; In English

Report No.(s): AD-A372066; AFIT/GLM/LAL/99S-6; No Copyright; Avail: CASI; A13, Hardcopy; A03, Microfiche

During the 1990's the Air Force experienced severe declines in serviceable inventory levels and a rise in their TNMCS rates. Air Force predictions of TNMCS hours during this time period did not account for the upward trend in TNMCS rates. The Air Force uses a regression equation, consisting of possessed hours, flying hours, and sorties, to predict TNMCS hours. This research, through simple linear regression, found a significant relationship between serviceable inventory levels and TNMCS rates for 8 of the 10 aircraft studied. Using this relationship, serviceable inventory levels were then added to the Air Force equations and new multiple regression equations were derived. Results indicate the addition of serviceable inventory as an explanatory variable renders a better Theil's U-statistic for each of the aircraft studied than the current predictions. The study recommends adding a logistics chain variable to TNMCS predictions and careful consideration of further reparable inventory reductions.

DTIC

Inventories; Fighter Aircraft; Reduction

20000024994 NASA Dryden Flight Research Center, Edwards, CA USA

Cryogenic Fuel Tank Draining Analysis Model

Greer, Donald, NASA Dryden Flight Research Center, USA; 1999; 9p; In English; Cryogenic Engineering, 12-16 Jul. 1999,

Montreal, Canada; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

One of the technological challenges in designing advanced hypersonic aircraft and the next generation of spacecraft is developing reusable flight-weight cryogenic fuel tanks. As an aid in the design and analysis of these cryogenic tanks, a computational fluid dynamics (CFD) model has been developed specifically for the analysis of flow in a cryogenic fuel tank. This model employs the full set of Navier-Stokes equations, except that viscous dissipation is neglected in the energy equation. An explicit finite difference technique in two-dimensional generalized coordinates, approximated to second-order accuracy in both space and time is used. The stiffness resulting from the low Mach number is resolved by using artificial compressibility. The model simulates the transient, two-dimensional draining of a fuel tank cross section. to calculate the slosh wave dynamics the interface between the ullage gas and liquid fuel is modeled as a free surface. Then, experimental data for free convection inside a horizontal cylinder are compared with model results. Finally, cryogenic tank draining calculations are performed with three different wall heat fluxes to demonstrate the effect of wall heat flux on the internal tank flow field.

Author

Computational Fluid Dynamics; Navier-Stokes Equation; Drainage; Cryogenic Fluid Storage; Finite Difference Theory; Cylindrical Tanks

20000025011 Defence Science and Technology Organisation, Aeronautical and Maritime Research Lab., Melbourne Australia

Inspection of Demonstrator Bonded Repairs on a QANTAS 747-300: September 1999

Geddes, Rowab C.; Nov. 1999; 23p; In English

Report No.(s): AD-A371953; DSTO-TR-0900; DODA-AR-011-135; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A visit to the QANTAS Jetbase at Sydney Airport was undertaken to inspect the condition of nine demonstrator bonded repairs which were applied to a Boeing 747, registration VH-EBW in 1990. The repairs had seen in excess of 37,000 hours of service since they were applied to regions of the aircraft which are susceptible to foreign object damage. Most of the repairs exhibited a degree of erosion damage, yet had still maintained their original bond integrity.

DTIC

Bonded Joints; Boeing 747 Aircraft; Damage; Impact Damage; Foreign Bodies

20000025013 Defence Science and Technology Organisation, Aeronautical and Maritime Research Lab., Melbourne Australia

F-111 Stiffener Run Out Number 2 Parametric Study

Paul, Julian; Oct. 1999; 52p; In English

Report No.(s): AD-A371994; DSTO-TN-0104; DODA-AR-010-301; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

The Royal Australian Air Force (RAAF) currently has in service a fleet of F-111 aircraft. The conditions under which the RAAF operates these aircraft have proved to be conducive to cracking in the structurally critical wing pivot fitting, and certification testing in the cold proof load test has demonstrated failures at that location. The RAAF has contracted Lockheed Martin Tactical Aircraft Systems (LMTAS) to perform a Durability and Damage Tolerance Analysis on the aircraft. One control point of concern, in this report, is the Stiffener Run Out Number 2 in the wing pivot fitting. The Aeronautical and Maritime Research Laboratory (AMRL) developed a bonded boron/epoxy reinforcement to reduce the high plastic strains in this critical region, and as a result has significant experience in analysing this region. LMTAS, in conjunction with the RAAF, requested that the AMRL perform an elastic and plastic stress analysis of Stiffener Run Out Number 2 including the effect of varying the geometric parameters associated with it.

DTIC

Aircraft Maintenance; Cracks; Stiffening; Airframes

20000025207 NASA Langley Research Center, Hampton, VA USA

Advancement of Bi-Level Integrated System Synthesis (BLISS)

Sobieszczanski–Sobieski, J., NASA Langley Research Center, USA; Emiley, Mark S., George Washington Univ., USA; Agte, Jeremy S., San Antonio Air Logistics Center, USA; Sandusky, Robert R., Jr., George Washington Univ., USA; [2000]; 12p; In English; 38th; 38th Aerospace Sciences Meeting, 10-13 Jan. 2000, Reno, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Report No.(s): AIAA Paper 2000-0421; Copyright Waived; Avail: CASI; A03, Hardcopy; A01, Microfiche

Bi-Level Integrated System Synthesis (BLISS) is a method for optimization of an engineering system, e.g., an aerospace vehicle. BLISS consists of optimizations at the subsystem (module) and system levels to divide the overall large optimization task into sets of smaller ones that can be executed concurrently. In the initial version of BLISS that was introduced and documented

in previous publications, analysis in the modules was kept at the early conceptual design level. This paper reports on the next step in the BLISS development in which the fidelity of the aerodynamic drag and structural stress and displacement analyses were upgraded while the method's satisfactory convergence rate was retained.
Author
Computer Systems Design; Multidisciplinary Design Optimization; Computer Aided Design; Aircraft Design

20000025234 NASA Langley Research Center, Hampton, VA USA
Rapid Model Fabrication and Testing for Aerospace Vehicles
Buck, Gregeory M., NASA Langley Research Center, USA; [2000]; 20p; In English; 38th; 38th Aerospace Sciences Meeting, 10-13 Jan. 2000, Reno, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Report No.(s): AIAA Paper 2000-0826; Copyright Waived; Avail: CASI; A03, Hardcopy; A01, Microfiche

Advanced methods for rapid fabrication and instrumentation of hypersonic wind tunnel models are being developed and evaluated at NASA Langley Research Center. Rapid aeroheating model fabrication and measurement techniques using investment casting of ceramic test models and thermographic phosphors are reviewed. More accurate model casting techniques for fabrication of benchmark metal and ceramic test models are being developed using a combination of rapid prototype patterns and investment casting. White light optical scanning is used for coordinate measurements to evaluate the fabrication process and verify model accuracy to +/- 0.002 inches. Higher temperature (is less than 210 C) luminescent coatings are also being developed for simultaneous pressure and temperature mapping, providing global pressure as well as global aeroheating measurements. Together these techniques will provide a more rapid and complete experimental aerodynamic and aerothermodynamic database for future aerospace vehicles.
Author
Fabrication; Wind Tunnel Tests; Aerothermodynamics; Wind Tunnel Models

20000025323 NASA Langley Research Center, Hampton, VA USA
The Influence of Modulated Signal Risetime in Flight Electronics Radiated Immunity Testing with a Mode-Stirred Chamber
Ely, Jay J., NASA Langley Research Center, USA; Nguyen, Truong X., NASA Langley Research Center, USA; Scearce, Stephen A., NASA Langley Research Center, USA; January 2000; 17p; In English; Original contains color illustrations
Contract(s)/Grant(s): RTOP 522-14-21-02
Report No.(s): NASA/TM-2000-209844; NAS 1.15:209844; L-17943; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

For electromagnetic immunity testing of an electronic system, it is desirable to demonstrate its functional integrity when exposed to the full range and intensity of environmental electromagnetic threats that may be encountered over its operational life. As part of this, it is necessary to show proper system operation when exposed to representative threat signal modulations. Modulated signal transition time is easily overlooked, but can be highly significant to system susceptibility. Radiated electromagnetic field immunity testing is increasingly being performed in Mode Stirred Chambers. Because the peak field vs. time relationship is affected by the operation of a reverberating room, it is important to understand how the room may influence any input signal modulation characteristics. This paper will provide insight into the field intensity vs. time relationship within the test environment of a mode stirred chamber. An understanding of this relationship is important to EMC engineers in determining what input signal modulation characteristics will be transferred to the equipment under test. References will be given for the development of this topic, and experimental data will be presented
Author
Field Tests; Service Life; Field Strength; Electromagnetic Compatibility

20000025333 NASA, Washington, DC USA
Touchdown: The Development of Propulsion Controlled Aircraft at NASA Dryden
Tucker, Tom, NASA, USA; 1999; 62p; In English; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

This monograph relates the important history of the Propulsion Controlled Aircraft project at NASA's Dryden Flight Research Center. Spurred by a number of airplane crashes caused by the loss of hydraulic flight controls, a NASA-industry team lead by Frank W. Burcham and C. Gordon Fullerton developed a way to land an aircraft safely using only engine thrust to control the airplane. In spite of initial skepticism, the team discovered that, by manually manipulating an airplane's thrust, there was adequate control for extended up-and-away flight. However, there was not adequate control precision for safe runway landings because of the small control forces, slow response, and difficulty in damping the airplane phugoid and Dutch roll oscillations. The team therefore conceived, developed, and tested the first computerized Propulsion Controlled Aircraft (PCA) system. The PCA system

takes pilot commands, uses feedback from airplane measurements, and computes commands for the thrust of each engine, yielding much more precise control. Pitch rate and velocity feedback damp the phugoid oscillation, while yaw rate feedback damps the Dutch roll motion. The team tested the PCA system in simulators and conducted flight research in F-15 and MD-11 airplanes. Later, they developed less sophisticated variants of PCA called PCA Lite and PCA Ultralite to make the system cheaper and therefore more attractive to industry. This monograph tells the PCA story in a non- technical way with emphasis on the human aspects of the engineering and flic,ht-research effort. It thereby supplements the extensive technical literature on PCA and makes the development of this technology accessible to a wide audience.
Derived from text
Flight Control; Propulsion; Thrust Control; Aircraft Control; Control Stability; Flight Management Systems; Maneuverability; Aircraft Stability

20000025557 NASA Langley Research Center, Hampton, VA USA
Improved Quality in Aerospace Testing Through the Modern Design of Experiments
DeLoach, R., NASA Langley Research Center, USA; [2000]; 24p; In English; 38th; 38th Aerospace Sciences Meeting and Exhibit, 10-13 Jan. 2000, Reno, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Report No.(s): AIAA Paper 2000-0825; Copyright Waived; Avail: CASI; A03, Hardcopy; A01, Microfiche

This paper illustrates how, in the presence of systematic error, the quality of an experimental result can be influenced by the order in which the independent variables are set. It is suggested that in typical experimental circumstances in which systematic errors are significant, the common practice of organizing the set point order of independent variables to maximize data acquisition rate results in a test matrix that fails to produce the highest quality research result. With some care to match the volume of data required to satisfy inference error risk tolerances, it is possible to accept a lower rate of data acquisition and still produce results of higher technical quality (lower experimental error) with less cost and in less time than conventional test procedures, simply by optimizing the sequence in which independent variable levels are set.
Author
Experiment Design; Q Factors; Systematic Errors; Data Acquisition

20000025766 NASA Glenn Research Center, Cleveland, OH USA
NASA/FAA Tailplane Icing Program: Flight Test Report
Ratvasky, Thomas P., NASA Glenn Research Center, USA; VanZante, Judith Foss, DYNACS Engineering Co., Inc., USA; Sim, Alex, NASA Dryden Flight Research Center, USA; March 2000; 166p; In English
Contract(s)/Grant(s): DTFA03-95-90001; RTOP 548-21-23
Report No.(s): NASA/TP-2000-209908; NAS 1.60:209908; DOT/FAA/AR-99/85; E-12126; No Copyright; Avail: CASI; A08, Hardcopy; A02, Microfiche

This report presents results from research flights that explored the characteristics of an ice-contaminated tailplane using various simulated ice shapes attached to the leading edge of the horizontal tailplane. A clean leading edge provided the baseline case, then three ice shapes were flown in order of increasing severity. Flight tests included both steady state and dynamic maneuvers. The steady state points were 1G wings level and steady heading sideslips. The primary dynamic maneuvers were pushovers to various G-levels; elevator doublets; and thrust transitions. These maneuvers were conducted for a full range of flap positions and aircraft angle of attack where possible. The analysis of this data set has clearly demonstrated the detrimental effects of ice contamination on aircraft stability and controllability. Paths to tailplane stall were revealed through parameter isolation and transition studies. These paths are (1) increasing ice shape severity, (2) increasing flap deflection, (3) high or low speeds, depending on whether the aircraft is in a steady state (high speed) or pushover maneuver (low speed), and (4) increasing thrust. The flight research effort was very comprehensive, but did not examine effects of tailplane design and location, or other aircraft geometry configuration effects. However, this effort provided the role of some of the parameters in promoting tailplane stall. The lessons learned will provide guidance to regulatory agencies, aircraft manufacturers, and operators on ice-contaminated tailplane stall in the effort to increase aviation safety and reduce the fatal accident rate.
Author
Aircraft Icing; Horizontal Tail Surfaces; Aircraft Stability; Leading Edges; Flight Tests

20000026835 Illinois Univ., Aviation Research Lab., Savoy, IL USA
An Informational Approach to Skill Transfer *Final Report, 21 Aug. 1993 - 20 Aug. 1997*
Lintern, Gavan, Illinois Univ., USA; Jan. 2000; 39p; In English
Contract(s)/Grant(s): MDA903-93-K-0006; Proj-201611022901
Report No.(s): AD-A372486; ARI-RN-2000-06; No Copyright; Avail: CASI; A01, Microfiche; A03, Hardcopy

This research program studied the nature of fundamental skills underlying the expertise of aircraft pilots. The research program included a review of the issues facing flight instruction. The specific tasks of landing a light aircraft and of navigating an aircraft through an unfamiliar area were selected for intensive study. The experimental projects undertaken in this program used a flight simulation system developed around a real time computer generated visual display. Two experimental paradigms were exploited. One was used to explore the visual information and skills used to support the aircraft landing task. As a means of identifying critical sources of information, experiments with experienced pilots examined how distortions in the simulated visual scene affected landing performance. The second paradigm evaluated transfer in a mission rehearsal task. A navigational database was developed and displayed via the visual simulation system. Flight students were taught navigational skills under different experimental conditions and were then tested in a realistic navigation condition.
DTIC
Flight Simulation; Aircraft Landing; Aircraft Pilots; Light Aircraft; Information Systems; Pilot Performance; Real Time Operation

20000026840 Fairchild Aircraft, San Antonio, TX USA
Development of a Supplemental Inspection Document for the Fairchild SA226 and SA227 Aircraft, Part 2
Dwyer, W., Fairchild Aircraft, USA; Oct. 1999; 255p; In English
Report No.(s): AD-A372525; DOT/FAA/AR-99/20-VOL-2-PT-2; No Copyright; Avail: CASI; A03, Microfiche; A12, Hardcopy
This report (consisting of volume I and volume II) is the second phase of a three-phase program sponsored by the Federal Aviation Administration to develop a supplemental inspection document for the Fairchild SA226 and SA227 aircraft. In this report, the results of material characterization and testing are presented. Crack growth analysis of all the critical structural elements using NASGRO is performed and the results documented.
DTIC
Aircraft Structures; Crack Propagation; Inspection; Aircraft Maintenance

20000026841 Fairchild Aircraft, San Antonio, TX USA
Development of a Supplemental Inspection Document for the Fairchild SA226 and SA227 Aircraft, Part 2
Dwyer, W., Fairchild Aircraft, USA; Oct. 1999; 633p; In English
Report No.(s): AD-A372526; DOT/FAA/AR-99/20-VOL-1-PT-2; No Copyright; Avail: CASI; A06, Microfiche; A99, Hardcopy
This report (consisting of volume I and volume II) is the second phase of a three-phase program sponsored by the Federal Aviation Administration to develop a supplemental inspection document for the Fairchild SA226 and SA227 aircraft. In this report, the results of material characterization and testing are presented. Crack growth analysis of all the critical structural elements using NASGRO is performed and the results documented.
DTIC
Crack Propagation; Inspection; Aircraft Structures

07
AIRCRAFT PROPULSION AND POWER

Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and onboard auxiliary power plants for aircraft.

20000020691 Department of Energy, Morgantown, WV USA
Overview of the DOE Advanced Turbine Systems Program
Layne, Abbie W., Department of Energy, USA; 1998 NASA Seal/Secondary Air System Workshop; July 1999; Volume 1, pp. 29-53; In English; No Copyright; Avail: CASI; A03, Hardcopy; A04, Microfiche
This paper presents a general overview of the DOE (Department of Energy) advanced turbine system in viewgraph form. Advanced turbine systems are being developed because 1) gas turbine power systems markets are rapidly growing to serve new demand, displacement or existing capacity and replacement of retired capacity; 2) environmental regulations continue to require reduced levels of air pollutants from power generation facilities; and 3) DOE shares risk/accelerates public benefits.
CASI
Gas Turbines; Market Research; Regulations; Air Pollution

20000020692 NASA Glenn Research Center, Cleveland, OH USA

GAP Program Overview

Burkardt, Leo, NASA Glenn Research Center, USA; 1998 NASA Seal/Secondary Air System Workshop; July 1999; Volume 1, pp. 55-77; In English; No Copyright; Avail: CASI; A03, Hardcopy; A04, Microfiche

NASA's General Aviation Propulsion (GAP) program is a cooperative program between government and industry. NASA's strategic direction is described by the "Three Pillars" and their Objectives as set forth by NASA Administrator Daniel S. Goldin. NASA's Three Pillars are: 1) Global Civil Aviation, 2) Revolutionary Technology Leaps, and 3) Access to Space.

Derived from text

General Overviews; Jet Propulsion; Civil Aviation; Gas Turbine Engines

20000020706 NASA Glenn Research Center, Cleveland, OH USA

Coupled, Transient Simulations of the Interaction Between Power and Secondary Flowpaths in Gas Turbines

Athavale, M. M., CFD Research Corp., USA; Przekwas, A. J., CFD Research Corp., USA; Li, H.–Y., CFD Research Corp., USA; Hendricks, Robert, NASA Glenn Research Center, USA; Steinetz, Bruce, NASA Glenn Research Center, USA; 1998 NASA Seal/Secondary Air System Workshop; July 1999; Volume 1, pp. 309-343; In English; No Copyright; Avail: CASI; A03, Hardcopy; A04, Microfiche

This paper presents a coupled analysis of the interaction between mainpath and secondary flowpaths in gas turbines using transient simulations. Some of the topics include: 1) Need for Coupled Analysis; 2) Primary-Secondary Coupling Schematic; 3) Secondary Flow Requirement; 4) Objectives of Present Methodology; 5) Current Methodologies Recap; 6) Proposed Coupled Code Methodology; 7) Description of SCISEAL Code; 8) Description of Turbo Code; 9) Code Coupling/Interface Issues; and 10) Current Interface Strategy. This paper is presented in viewgraph form.

CASI

Secondary Flow; Gas Turbines; Computerized Simulation; Applications Programs (Computers); Coupled Modes

20000020707 NASA Glenn Research Center, Cleveland, OH USA

NPSS Engine Systems Simulations

Veres, Joseph P., NASA Glenn Research Center, USA; 1998 NASA Seal/Secondary Air System Workshop; July 1999; Volume 1, pp. 345-363; In English; No Copyright; Avail: CASI; A03, Hardcopy; A04, Microfiche

This paper presents NPSS (Numerical Propulsion System Simulation) Engine Systems Simulations in viewgraph form. The topics include: 1) Multidisciplinary Design Optimization Using UG/WAVE; 2) Flow Solver for National Combustion Code; 3) National Combustion Code Computing Framework; 4) National Combustion Code; 5) Low Pressure Subsystem 3-D Model; 6) Flow Simulation of the EEE (Energy Efficient Engine) Gas Turbine Low Pressure Subsystem; 7) Turbine Blade Tip and Outer Air Seal; and 8) Eng 20 Simulation of Turbofan Engine.

CASI

Computerized Simulation; Turbofan Engines; Propulsion System Performance; Combustion

20000020789 Research and Technology Organization, Applied Vehicle Technology Panel, Neuilly-sur-Seine, France

Design Principles and Methods for Aircraft Gas Turbine Engines ***Les Principes et Methodes de Conception des Turbomoteurs***

Design Principles and Methods for Aircraft Gas Turbine Engines; February 1999; 482p; In English; In French, 11-15 May 1998, Toulouse, France; See also 20000020790 through 20000020828; Original contains color illustrations

Report No.(s): RTO-MP-8; AC/323(AVT)TP/9; ISBN 92-837-0005-8; Copyright Waived; Avail: CASI; A21, Hardcopy; A04, Microfiche

The symposium dealt with design approaches for military aircraft propulsion systems to provide enhanced operational flexibility, longer range, better fuel efficiency and improved affordability. All classes of gas turbines were addressed in nine sessions as follows: Engine Design and Analysis (Part 1) (5 papers); Mechanical Systems (6 papers) Controls (4 papers); Combustors/Augmentors (4 papers); Compressor Systems (Part 1) (5 papers); Compressor Systems (Part 2) (3 papers); Turbines (Part 1) (5 papers); Turbines (Part 2) (4 papers); and Engine Design and Analysis (Part 2) (4 papers). These proceedings also include a Technical Evaluation Report and a Keynote address published in French and English.

Derived from text

Aircraft Engines; Gas Turbine Engines; Engine Parts; Conferences; Engine Design

20000020790 Air Force Research Lab., Propulsion Directorate, Wright-Patterson AFB, OH USA
The Gas Turbine Engine Conceptual Design Process: An Integrated Approach
Stricker, Jeffrey M., Air Force Research Lab., USA; Design Principles and Methods for Aircraft Gas Turbine Engines; February 1999, pp. 1-1 - 1-9; In English; See also 20000020789; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

The conceptual design process of gas turbine engines is complex, involving many engineering disciplines. Aerodynamics, thermodynamics, heat transfer, materials science, component design, and structural analysis are a few of the fields employed when down selecting an appropriate engine configuration. Because of the complexity involved, it is critical to have a process that narrows engine options without missing the "optimum". The following paper describes a typical process used at the conceptual design level. The various steps that will be described include propulsion requirements definition, engine cycle analysis, component design, flowpath/weight prediction, installation, and engine design influence on aircraft size and performance. The engine design process is not completely linear since the steps listed above are highly interdependent. A number of iterations are usually necessary in selecting a final engine configuration. This paper will describe several of the inter-relationships between the various steps. Frequently, a particular aircraft system has special requirements that influence the design selection process. Some modem day examples of these criteria include reduced observables and cost reduction. How these variations arc incorporated into the conceptual design process will be discussed.
Derived from text
Engine Design; Gas Turbine Engines; Structural Analysis; Thermodynamics; Weight Analysis

20000020791 Motoren- und Turbinen-Union G.m.b.H., Munich, Germany
Design of a New Fighter Engine: The Dream in an Engine Man's Life
Schaeffler, A., Motoren- und Turbinen-Union G.m.b.H., Germany; Lauer, W., Motoren- und Turbinen-Union G.m.b.H., Germany; Design Principles and Methods for Aircraft Gas Turbine Engines; February 1999, pp. 2-1 - 2-7; In English; See also 20000020789; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

In 1984-85 a feasibility study between 5 European Nations France, Germany, Italy, Spain and UK for a common air superiority fighter was pursued which ended in 4 Nations to step into the Definition Phase in autumn 85. For us this was the beginning of an exciting experience in various roles as MTU Chief Engineers and Technical Directors of Eurojet Turbo GmbH, i.e. Chairmen of the Chief Engineers' meeting. Designing a brand new fighter engine at the very edge of technology is an occasion so seldom that given the opportunity to take a lead function in such a multi-billion dollar project is a dream, which only few enjoy once a life.
Derived from text
Fighter Aircraft; Aircraft Engines; Design

20000020792 Rolls-Royce Ltd., Military Aero Engines, Bristol, UK
Designing for Reliability: The Rolls-Royce Approach
Hopper, P. J., Rolls-Royce Ltd., UK; Design Principles and Methods for Aircraft Gas Turbine Engines; February 1999, pp. 3-1 - 3-5; In English; See also 20000020789; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

In today's highly competitive world market, where safety, reliability and operating costs of equipment are often paramount, there are many drivers to maintaining a viable, and economic operation. This is as true in the world of-aerospace as in any other. Aircraft on the ground neither win wars for armed forces nor earn revenue for civil operators. It is against this background that the Rolls-Royce Aerospace Group has as one of its primary objectives the "provision of reliable, and safe products and services which meet the expectations and specified requirements" of its various customers. These include both military and civil operators, and various regulatory authorities. The task of the Company is therefore to realise the challenge in meeting these safety and reliability requirements in both the civil and military markets at the entry into service of its projects.
Derived from text
Reliability; Operating Costs; Economics; Market Research

20000020793 Pratt and Whitney Aircraft of Canada Ltd., Longueuil, Quebec Canada
The PW100 Engine: 20 Years of Gas Turbine Technology Evolution
Hosking, E., Pratt and Whitney Aircraft of Canada Ltd., Canada; Kenny, D. P., Pratt and Whitney Aircraft of Canada Ltd., Canada; McCormick, R. I., Pratt and Whitney Aircraft of Canada Ltd., Canada; Moustapha, S. H., Pratt and Whitney Aircraft of Canada Ltd., Canada; Sampath, P., Pratt and Whitney Aircraft of Canada Ltd., Canada; Smailys, A. A., Pratt and Whitney Aircraft of Canada Ltd., Canada; Design Principles and Methods for Aircraft Gas Turbine Engines; February 1999, pp. 4-1 - 4-9; In English; See also 20000020789; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

The PW100 three-spool turboprop engine family has been designed for the commuter, utility and executive aircraft markets. The first PW 100 engine, with a thermal power rating of 1780 Kw, entered service in the mid-1980s. Growth through increased pressure ratio and turbine inlet temperature as well as application of new technology has allowed the power of the engine to reach 4980 Kw for the latest PW150. This paper will highlight examples of this technical evolution covering the cold and hot end, gearbox, installation and control systems and the application of the latest three-dimensional aerodynamic and stress analysis to the design of the different components.
Derived from text
Gas Turbines; Turboprop Engines; Stress Analysis

20000020794 Daimler-Benz Aerospace A.G., Munich, Germany
Process Optimization in Advanced Compressor Design
Schulze, Gisbert, Motoren- und Turbinen-Union G.m.b.H., Germany; Geidel, Helmut A., Motoren- und Turbinen-Union G.m.b.H., Germany; Pirker, Klaus, Motoren- und Turbinen-Union G.m.b.H., Germany; Design Principles and Methods for Aircraft Gas Turbine Engines; February 1999, pp. 6-1 - 6-8; In English; See also 20000020789; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

After an overview of MTU's current compressor projects, this paper focuses towards the fundamentals of the team oriented integrated product design process(IPD) and a new approach to its goals, the advanced multi-disciplinary design process. The new idea behind this process is the focus on the integration of the most important design skills in one person. Most of the compressor design work is performed by the same person with the support of a team of specialists of the different disciplines rather than carrying out the different tasks by different members of the team. The goal of this process is a further reduction in development lead time and cost and a better focus on project requirements rather than on certain discipline requirements.
Author
Compressors; Costs; Design; Optimization; Design to Cost; Design Analysis

20000020795 Fiat Aviazione S.p.A., Direzione Tecnica, Turin, Italy
Actuation System for Variable Exhaust Nozzle and Inlet Guide Vanes on an Advanced Gas Turbine Engine
Bardone, G., Fiat Aviazione S.p.A., Italy; Marchetti, S., Fiat Aviazione S.p.A., Italy; Trovati, A., Fiat Aviazione S.p.A., Italy; Design Principles and Methods for Aircraft Gas Turbine Engines; February 1999, pp. 7-1 - 7-17; In English; See also 20000020789; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

Aircraft engines with afterburner need to have variable exhaust nozzle and inlet guide vanes in order to control the air flow. Different types of actuation systems provide the force to move such variable geometry devices. The paper describes the architecture of a hydraulic actuation system installed on a military engine of the last generation, paying particular attention to the technical solutions chosen to keep at minimum mass and heat re.jection and to the dynamic mathematical model used during the development to predict the nozzle area behaviour, inlet guide vanes position, hydraulic oil flows and pressures as functions of external loads, engine rating and commanded positions.
Author
Actuators; Exhaust Nozzles; Intake Systems; Guide Vanes; Gas Turbine Engines; Afterburning

20000020796 Turbomeca S.A. - Brevets Szydlowski, Bordes, France
The Reliability of Aeronautical Bearings and Their Behavior in Fatigue ***La Fiabilite des Roulements Aeronautiques et le Comportement en Fatigue***
Cheftel, Brigitte, Turbomeca S.A. - Brevets Szydlowski, France; Paty, Gerard, Turbomeca S.A. - Brevets Szydlowski, France; Design Principles and Methods for Aircraft Gas Turbine Engines; February 1999, pp. 8-1 - 8-6; In French; See also 20000020789 Contract(s)/Grant(s): BRE2-CT92-0209; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

Gas turbine bearings are mechanical components which influence engine performance through this reliability. They link rotating parts to stationary ones. A bearing failure may have serious consequences such as engine out of order or aeroship maneuverability losses. Engine improvements through SFC and weight/power ratio lead to increase rotational speeds and other parameters such as applied loads and bulk temperature. As other engine manufacturers, TURBOMECA use to design bearings such to prevent typical failures observed on field. The fatigue defect is the most important to be addressed. In this context, it has been raised that an endurance limit under which no fatigue is developed exists. A research programme named "ELABOMM" involving bearings and turbine engines Manufacturers and University and funded by the CEC was conducted during four years in order to identify the influencing parameters and the threshold of this endurance limit in dependence of their value. It resulted

a model and a databank available at the en 'gine manufacturer offices which can be used to design bearings with confidence relatively to the expected fatigue behaviour.
Author
Reliability; Gas Turbines; Turbine Engines; Bearings; Failure; Fatigue (Materials)

20000020797 Air Force Research Lab., Propulsion Directorate, Wright-Patterson AFB, OH USA
Computer Modeling of Heat Generation in Vapor Lubricated Bearings for Gas Turbines
Forster, Nelson H., Air Force Research Lab., USA; Givan, Garry D., Air Force Research Lab., USA; Design Principles and Methods for Aircraft Gas Turbine Engines; February 1999, pp. 9-1 - 9-10; In English; See also 20000020789; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

Analytical and experimental data are presented for a 30 mm bore ball bearing operating at 31,000 rpm (0.93 MDN where MDN=l0(exp -6) x shaft diameter x shaft rpm), applied thrust load of 445 N (1.0 GPa maximum Hertzian contact stress), and a steady-state bulk outer race temperature of 425 C (135 C above the initial static temperature of 290 C). The bearing was lubricated with a tertiary-butyl phenyl phosphate (TBPP) delivered from the vapor phase at 325 C. The steady-state bearing torque, at the conditions described above, was 0.07 N-m, resulting in a bearing power loss of 227 W. The major advantage of vapor lubrication in gas turbines is the potential to eliminate the conventional liquid lubrication system, resulting in considerable weight and cost savings benefits. The major disadvantage of vapor lubrication, is the inability to remove the bearing heat generation due to loss of the recirculating liquid lubricant. Although heat transfer poses potential problems, the higher temperature capability of the TBPP vapor lubricant, 600 C compared to 200 C for a recirculating polyester liquid lubricant, may enable the vapor lubricant to withstand this higher heat generation. This paper takes a first look at examining heat generation in vapor lubricated bearings. to accomplish this, friction measurements were made in a single bearing contact under controlled conditions of rolling and sliding. Tile lubricant was delivered as vapor to the bearing contact. Friction measurements were made at ball temperatures of 300 C and 400 C; stress loads of 0.75 GPa, 1.00 GPa, 1.25 GPa, and 1.50 GPa; and rolling speeds of 10 m/s and 15 m/s. Using the friction measurement as input data, analysis of the bearing was performed at the experimental test conditions using the bearing computer program ADORE. After validating the computer model to match the experimental bearing heat generation, parametric computer runs were made for the bearing geometry operating at conditions of 1.0 MDN to 2.0 MDN, and applied contact loads of 1.0 GPa and 2.0 GPa. Under the most severe case, 2.0 MDN and 2.0 GPa of contact stress, the 30 mm bore test bearing is expected to generate 3742 watts of heat. Additional analysis is required to convert this heat input to the expected operational bearing temperature, but the results suggest that improved heat transfer will be required to meet the conditions at 2.0 MDN and 2.0 GPa of Hertzian contact stress.
Author
Computerized Simulation; Vapor Phases; Lubrication Systems; Lubricants; Heat Generation; Ball Bearings

20000020798 NASA Lewis Research Center, Cleveland, OH USA
Advanced Seal Technology Role in Meeting Next Generation Turbine Engine Goals
Steinetz, Bruce M., NASA Lewis Research Center, USA; Hendricks, Robert C., NASA Lewis Research Center, USA; Munson, John, Allison Engine Co., USA; Design Principles and Methods for Aircraft Gas Turbine Engines; February 1999, pp. 11-1 - 11-13; In English; See also 20000020789; Original contains color illustrations; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

Cycle studies have shown the benefits of increasing engine pressure ratios and cycle temperatures to decrease engine weight and improve performance in next generation turbine engines. Advanced seals have been identified as critical in meeting engine goals for specific fuel consumption, thrust-to-weight, emissions, durability and operating costs. NASA and the industry are identifying and developing engine and sealing technologies that will result in dramatic improvements and address the goals for engines entering service in the 2005-2007 time frame. This paper provides an overview of advanced seal technology requirements and highlights the results of a preliminary design effort to implement advanced seals into a regional aircraft turbine engine. This study examines in great detail the benefits of applying advanced seals in the high pressure turbine region of the engine. Low leakage film-riding seals can cut in half the estimated 4% cycle air currently used to purge the high pressure turbine cavities. These savings can be applied in one of several ways. Holding rotor inlet temperature (RIT) constant the engine specific fuel consumption can be reduced 0.9%, or thrust could be increased 2.5%, or mission fuel burn could be reduced 1.3%. Alternatively, RIT could be lowered 20 'F resulting in a 50% increase in turbine blade life reducing overall regional aircraft maintenance and fuel bum direct operating costs by nearly 1%. Thermal, structural, secondary-air systems, safety (seal failure and effect), and emissions analyses have shown the proposed design is feasible.
Author
Sealing; Aircraft Engines; Turbine Engines; Pressure Ratio; Gas Turbine Engines

20000020799 Motoren- und Turbinen-Union G.m.b.H., Munich, Germany

Fuel/Oil System Thermal Management in Aircraft Turbine Engines

Streifinger, Helmut, Motoren- und Turbinen-Union G.m.b.H., Germany; Design Principles and Methods for Aircraft Gas Turbine Engines; February 1999, pp. 12-1 - 12-10; In English; See also 20000020789; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

The fuel consumed by an aircraft turbine engine is the preferred heat sink for its lubrication, hydraulic, and integrated drive generator oil systems. Reasons for this are, that a fuel/oil heat exchanger is more compact, if compared with an air/oil cooler, and causes no drag increase and no engine performance loss from air bleed or loss of momentum of the air. Furthermore, the energy exchanged in the fuel/oil cooler is conserved in the thermodynamic cycle. ne capacity of the fuel as a heat sink is temperature limited, however, and the fuel pumps contribute to the fuel heating as well. Integration of the fuel and oil systems to a thermal management system is required, which performs its functions without exceeding fuel or oil temperature limits within the aircraft flight envelope. to make this possible, reduction of the oil system heat rejection, as well as the installation of air/oil heat exchangers, has to be considered early in the engine development programme (Ref. 1). A continuous analysis of the heat loads from fuel and oil systems is required, until sufficient test evidence proves that the design meets the requirements.

Derived from text

Management Systems; Fuel Oils; Thermodynamic Cycles; Turbine Engines; Aircraft Engines; Systems Management

20000020800 Rolls-Royce Ltd., Military Aero Engines, Bristol, UK

Fault Tolerant Design Methodology in Software for Safety Related Systems

Cockram, Trevor, Rolls-Royce Ltd., UK; Design Principles and Methods for Aircraft Gas Turbine Engines; February 1999, pp. 13-1 - 13-6; In English; See also 20000020789

Contract(s)/Grant(s): DTI Project IED4/1/9004; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

System failures caused by software are not caused by wear out; they are due to errors in the design or specification of the software. Most activities during the software development process have the potential to cause errors in the final software code. An important mechanism in this type of systematic error is human error, both as individuals and within groups. Adherence to procedures or standards implies a kind of fault tolerant design. However, in order to judge whether practices are effective at achieving the required integrity of the product, a measurement based approach to software design is required. The methodology described has been developed to provide project managers with a means to assess the integrity of the software product at any stage prior to delivery. The product integrity is described in terms of the probability distribution for the numbers of errors that exist in any product or set of products. The approach is equally applicable to determine the effectiveness of the quality assurance processes and of any error correction mechanism including software maintenance. The methodology is supported by a tool that uses graphical probability models to describe each atomic development or review process, defining the dependencies between the process attributes. Bayesian statistics are then used to calculate the integrity prediction using a priori experience together with evidence.

Author

Systematic Errors; System Failures; Quality Control; Procedures; Fault Tolerance; Error Analysis

20000020801 Technical Univ. of Munich, Lehrstuhl fuer Flugantriebe, Muchen, Germany

Monitoring and Control of Helicopter Engines at Abnormal Operating Conditions

Erhard, W., Technical Univ. of Munich, Germany; Gabler, R., Technical Univ. of Munich, Germany; Preiss, A., Technical Univ. of Munich, Germany; Rick, H., Technical Univ. of Munich, Germany; Design Principles and Methods for Aircraft Gas Turbine Engines; February 1999, pp. 14-1 - 14-10; In English; See also 20000020789; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

A digital non-flight standard control system for the helicopter engine ALLISON 250-C20B has been developed. It is used as a development slave system at the institute's test bed for various research projects. The topics to be presented in this paper cover control and monitoring aspects for these types of engines in the presence of abnormal operating conditions. Investigated are compressor rotating stall and surge due to engine failure, control system failure, inlet distortion, as well as water ingestion problems. to get control over the operating line of the engine and to avoid, respectively to abort a surge condition an appropriate bleed valve can be used. Therefore the original valve is replaced by a newly developed simple and cost effective one which is integrated into the electronic control system and can be controlled by software. The software itself is developed with means of an object oriented tool and runs on a rapid prototyping real-time computer. to detect stall and surge onset as early as possible different methods of signal analysis are applied and investigated. The wavelet method as a relatively new one proved to be very interesting for such applications. But it emerged that in many cases, particularly at slam accelerations, it was not possible to avoid

surge entirely with the developed system, because of insufficient actuator dynamics. Therefore a special control mode was developed to abort surge immediately and recover to normal operation.
Author
Helicopter Engines; Electronic Control; Wavelet Analysis; System Failures; Real Time Operation; Engine Failure; Abnormalities

20000020802 Purdue Univ., School of Mechanical Engineering, West Lafayette, IN USA
Simultaneous Active Source Control of Blade Row Interaction Generated Discrete Tones
Sawyer, Scott, Purdue Univ., USA; Fleeter, Sanford, Purdue Univ., USA; Design Principles and Methods for Aircraft Gas Turbine Engines; February 1999, pp. 15-1 - 15-11; In English; See also 20000020789; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

Unsteady blade row interactions in turbomachines generate discrete-frequency tones at blade pass frequency and its harmonics. Specific circumferential acoustic modes are generated. However, only certain of these modes propagate upstream and downstream to the far field, with these the discrete frequency noise received by an observer. This paper is directed at experimentally demonstrating the viability of active noise control utilizing active airfoils to generate propagating spatial modes that interact with and simultaneously cancel the upstream and downstream propagating acoustic modes. This is accomplished by means of fundamental experiments performed in the Purdue Annular Cascade Research Facility configured with 16 rotor blades and 18 stator vanes. At blade pass frequency, only the k(sub 0) = -2 spatial mode propagates. Significant simultaneous noise reductions are achieved for these upstream and downstream propagating spatial modes over a wide range of operating conditions.
Author
Active Control; Airfoils; Noise Reduction; Turbomachinery; Rotor Blades (Turbomachinery)

20000020803 Naval Air Warfare Center, Propulsion Fuel Systems, Controls and Diagnostics, Patuxent River, MD USA
Improved Gas Turbine Response Using LQR Control
Richman, Mike, Naval Air Warfare Center, USA; Gordon, Vernon, Naval Air Warfare Center, USA; Design Principles and Methods for Aircraft Gas Turbine Engines; February 1999, pp. 16-1 - 16-9; In English; See also 20000020789; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

This paper develops a design methodology for a full state feedback controller using linear quadratic regulator (LQR) multivariable control techniques. The result is a controller that will perform with the quickest settle time, containing optimal stability margin while minimizing the feedback gains to realistic real world values. A correlation will be established between the weighting parameters used in a typical LQR design and their effect on steady state settle time and maximum feedback gain. The entire investigation uses MATLAB with Simulink, including an assortment of control system toolboxes, to design, trend, and evaluate the System with and without the full state feedback controller. A Simulink block diagram was used to design and test a full-state feedback controller. Settle time, maximum feedback gain, and steadystate values were plotted as a function of LQR design parameters Q and R. These parameters weight either the state or control energy for optimization. Choosing a Q identity matrix of 10 and R identity matrix of 0.1 the system was evaluated with both a step input and a sine wave input. The controlled system reduced the steady state settle time by .5 seconds over the open loop step response.
Author
Gas Turbines; Stability; Multivariable Control; Feedback; Design Analysis; Control Systems Design

20000020804 Virginia Polytechnic Inst. and State Univ., Mechanical Engineering Dept., Blacksburg, VA USA
Unsteady, Finite-Rate Model for Application in the Design of Complete Gas-Turbine Combustor Configurations
Rodriguez, Carlos G., Virginia Polytechnic Inst. and State Univ., USA; OBrien, Walter F., Virginia Polytechnic Inst. and State Univ., USA; Design Principles and Methods for Aircraft Gas Turbine Engines; February 1999, pp. 17-1 - 17-11; In English; See also 20000020789; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

Design methods for gas-turbine engine combustors require mathematical models that satisfy two simultaneous and often conflicting requirements: to provide an accurate description of the highly complex geometry and physics involved, and be sufficiently inexpensive in computational requirements as to allow its incorporation in a design cycle involving the evaluation of a great number of operating conditions. For these reasons a one-dimensional, finite-rate, unsteady combustor model has been developed that incorporates most elements found in modem gas-turbine burners, and yet is simple enough to be implemented in desktop computers. The model includes the division of the flowpath into annular and primary streams, finite-rate effects within the primary flow, and interaction between hot and cold gases though dilution holes. Examples show predictions of flow

distribution within complete burner configurations, blowout predictions, and the effects of perturbations in boundary and operating conditions.
Author
Unsteady State; Combustion Chambers; Gas Turbine Engines; Mathematical Models

20000020805 Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Inst. for Propulsion Technology, Cologne, Germany
Design Principles for the Quench Zone of Rich-Quench-Lean Combustors
Hassa, C., Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Germany; Migueis, C. E., Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Germany; Voigt, P., Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Germany; Design Principles and Methods for Aircraft Gas Turbine Engines; February 1999, pp. 18-1 - 18-11; In English; See also 20000020789; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

Isothermal experiments on the mixing of jet rows in crossflow with particular attention to the quench zone mixing of RQL combustor have been carried out. Comparing mixing with combusting and isothermal mixing, it could be demonstrated, that with the combination of jet air concentration measurements and numerical calculations of the flow, medium pressure combustion tests with 3-D probe measurements can be bypassed for the jet row optimization. The study with homogenuous crossflow for RQL combustors without cooling air in the primary zone showed optimum mixing with two staggered rows with close axial spacing. The light sheet technique could be demonstrated to give good quantitative results with higher spatial resolution than any other competing technique if applied with the appropriate care. Its application clearly revealed the influence of swirling, recirculating primary zone flow on the jet mixing.
Author
Design Analysis; Combustion Chambers; Fluid Jets; Jet Mixing Flow; Swirling

20000020806 Fiat Aviazione S.p.A., Direzione Tecnica, Turin, Italy
Afterburner Design and Development
Trovati, A., Fiat Aviazione S.p.A., Italy; Turrini, F., Fiat Aviazione S.p.A., Italy; Vinci, C., Fiat Aviazione S.p.A., Italy; Design Principles and Methods for Aircraft Gas Turbine Engines; February 1999, pp. 19-1 - 19-24; In English; See also 20000020789; Original contains color illustrations; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

The paper deals with the design and the development of the afterburner system for an advanced fighter aircraft. The design background of the system and its major components is given, in front of design requirements. The design process is described, Outlining most important design tools, with particular attention to CFD and aerothermal modelling. The principal experimental evidences are also presented. showing the most significant achievements of system development and giving a survey of major problems and relevant solutions during the system development and optimisation process.
Author
Afterburning; Design Analysis; Manufacturing

20000020807 Motoren- und Turbinen-Union G.m.b.H., Engine System Simulation TPSZ, Munich, Germany
A Mixed Flow Turbofan Afterburner Simulation for the Definition of Reheat Fuel Control Laws
Kurzke, Joachim, Motoren- und Turbinen-Union G.m.b.H., Germany; Riegler, Claus, Deutsches Zentrum fuer Luft- und Raumfahrt e.V., Germany; Design Principles and Methods for Aircraft Gas Turbine Engines; February 1999, pp. 20-1 - 20-12; In English; See also 20000020789; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

The afterburner fuel flow control for mixed flow turbofan engines is a complex task. At a given nozzle area, burning too much afterburner fuel can throttle the fan until it surges. On the contrary - when not enough heat is released - the fan pressure ratio will decrease and the gas velocity in the jet pipe will rise with the dan;er of blowing out the flame. Ideally, the operating point of the fan in its map should not be affected by the afterburner operation. Two different methods are in use to achieve this at least approximately. In some engines the afterburner fuel flow is controlled 'closed loop' so that a prescribed fan pressure ratio is achieved. The problem with this approach is that in case of an unexpected afterburner ignition delay the nozzle will close with the aim to keep the fan pressure ratio at the target level. When the afterburner fuel ignites in such a situation unexpectedly the nozzle probably cannot open quickly enough and therefore the pressure in the afterburner will rise sharply. This can result in a fan surge.
Derived from text
Turbofans; Afterburning; Simulation; Control Theory; Fuel Control; Multiphase Flow

20000020808 NASA Lewis Research Center, Cleveland, OH USA

Numerical Simulation of Multi-Stage Turbomachinery Flows

Adamczyk, John J., NASA Lewis Research Center, USA; Hathaway, Michael D., NASA Lewis Research Center, USA; Shabbir, Aamir, NASA Lewis Research Center, USA; Wellborn, Steven R., NASA Lewis Research Center, USA; Design Principles and Methods for Aircraft Gas Turbine Engines; February 1999, pp. 21-1 - 21-25; In English; See also 20000020789; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

A comprehensive assessment is made of the predictive capability of the average passage flow model as applied to multi-stage axial flow compressors. The average passage flow model describes the time average flow field within a typical passage of a blade row embedded in a multi-stage configuration. In this work data taken within a four and one-half stage large low speed compressor will be used to assess the weakness and strengths of the predictive capabilities of the average passage flow model. The low speed compressor blading is of modern design and employs stators with end-bends. Measurements were made with slow and high response instrumentation. The high response measurements revealed the velocity components of both the rotor and stator wakes. Based on the measured wake profiles it will be argued that blade boundary layer transition is playing an important role in setting compressor performance. A model which mimics the effects of blade boundary layer transition within the frame work of the average passage model will be presented. Simulations which incorporated this model showed a dramatic improvement in agreement with data.

Author

Numerical Analysis; Computerized Simulation; Embedding; Flow Distribution; Prediction Analysis Techniques; Turbomachinery

20000020809 Turbomeca S.A. - Brevets Szydlowski, Aerothermodynamic Dept., Bordes, France

Performance Analysis of Centrifugal Compressor Stage, by Means of Numerical and Experimental Investigation of Rotor-Stator Interactions

Domercq, O., Turbomeca S.A. - Brevets Szydlowski, France; Thomas, R., Turbomeca S.A. - Brevets Szydlowski, France; Carrere, A., Ecole Nationale Superieure de l'Aeronautique et de l'Espace, France; Design Principles and Methods for Aircraft Gas Turbine Engines; February 1999, pp. 22-1 - 22-12; In English; See also 20000020789; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

This paper deals with numerical and experimental investigations of rotor-stator interactions between a backswept centrifugal impeller and its associated vaned diffuser. Experimental data were obtained by laser two focus velocimetry and fast response Kulite transducers. Computations were carried out thanks to a three-dimensional Navier-Stokes solver, customized by the authors, for the current purpose. Time-resolved simulations of the full stage with passages number reduction but respect to real geometry of components are then presented. Comparisons with experimental data lead to a code validation phase and critic investigations of rotor-stator interaction phenomena. Evidence of the existence of a strong interaction between the rotor and the stator flow fields are pointed out. In particular, an intense upstream influence of the vaned diffuser was observed. Finally, steady stage calculations, coupling the components by a mean interfacial treatment, are examined. The reasonable computational cost of this method now allows such numerical simulations of centrifugal stages to be part of design cycles. The numerical part of the study was performed at Turbomeca, using the local software and hardware facilities, whereas the experimental campaign took place in the Propulsion Laboratory of SUPAERO, part of the LAMEP (Laboratoire Mixte en Energetique et Propulsion), which recently designed a test rig devoted to compressors.

Author

Centrifugal Compressors; Centrifugal Force; Computer Programs; Numerical Analysis; Experimentation; Reliability Analysis; Rotor Stator Interactions

20000020810 Von Karman Inst. for Fluid Dynamics, Turbomachinery Dept., Rhode-Saint-Genese, Belgium

Three-Dimensional Inverse Design Method for Turbine and Compressor Blades

Demeulenaere, A., Von Karman Inst. for Fluid Dynamics, Belgium; VandenBraembussche, R. A., Von Karman Inst. for Fluid Dynamics, Belgium; Design Principles and Methods for Aircraft Gas Turbine Engines; February 1999, pp. 23-1 - 23-9; In English; See also 20000020789; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

An iterative procedure for turbomachinery blade design, in which the three-dimensional blade shape is modified by means of a physical algorithm and the transpiration model, is presented. The transpiration flux is defined from the velocity normal to the wall, computed by means of a modified Euler solver when the target pressure distribution is imposed along the blade surfaces. This method is very efficient as it needs only a limited amount of computer time to obtain the required geometry. After a short description of the method this paper focuses on some special features that have been introduced to enhance convergence and to

facilitate compliance with required performances and mechanical constraints. Each of these techniques is illustrated with an example.
Author
Computer Aided Design; Turbine Blades; Compressor Blades; Iterative Solution; Reverse Engineering; Algorithms

20000020811 NASA Lewis Research Center, Cleveland, OH USA
A One Dimensional, Time Dependent Inlet/Engine Numerical Simulation for Aircraft Propulsion Systems
Garrard, Doug, Sverdrup Technology, Inc., USA; Davis, Milt, Jr., Sverdrup Technology, Inc., USA; Cole, Gary, NASA Lewis Research Center, USA; Design Principles and Methods for Aircraft Gas Turbine Engines; February 1999, pp. 25-1 - 25-10; In English; See also 20000020789
Contract(s)/Grant(s): NASA Order C-71064-E; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

The NASA Lewis Research Center (LeRC) and the Arnold Engineering Development Center (AEDC) have developed a closely coupled computer simulation system that provides a one dimensional, high frequency inlet/engine numerical simulation for aircraft propulsion systems. The simulation system, operating under the LeRC-developed Application Portable Parallel Library (APPL), closely coupled a supersonic inlet with a gas turbine engine. The supersonic inlet was modeled using the Large Perturbation Inlet (LAPIN) computer code, and the gas turbine engine was modeled using the Aerodynamic Turbine Engine Code (ATEC). Both LAPIN and ATEC provide a one dimensional, compressible, time dependent flow solution by solving the one dimensional Euler equations for the conservation of mass, momentum, and energy. Source terms are used to model features such as bleed flows, turbomachinery component characteristics, and inlet subsonic spillage while unstarted. High frequency events, such as compressor surge and inlet unstart, can be simulated with a high degree of fidelity. The simulation system was exercised using a supersonic inlet with sixty percent of the supersonic area contraction occurring internally, and a GE J85-13 turbojet engine.
Author
Engine Design; Computerized Simulation; Supersonic Inlets; Propulsion System Configurations; Mathematical Models; Applications Programs (Computers)

20000020813 Rolls-Royce Ltd., Derby, UK
The Introduction of Reinforced TMC Materials Into Rotating Machinery: The Safe Approach
Doorbar, P. J., Rolls-Royce Ltd., UK; Design Principles and Methods for Aircraft Gas Turbine Engines; February 1999, pp. 27-1 - 27-7; In English; See also 20000020789; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

Titanium metal matrix composites (TMCs) will play a significant role in the future of gas turbine aero-engine development, in particular when used for rotating disc/blade assemblies in axial flow compressors. This paper outlines the potential applications for TMCs and covers some of the main issues involved in the safe introduction of this relatively new class of composite material into critical engine components. The key microstructural features which affect the mechanical performance of finished components are explained, (e.g. fibre damage, fibre placement, interfacial bonding and embrittlement etc.) and illustrations are given of how they can be controlled in the manufacturing process for a complex component.
Author
Metal Matrix Composites; Turbocompressors; Engine Parts

20000020814 Technische Univ., Dept. of Gas Turbines and Flight Propulsion, Darmstadt, Germany
Design of an Active Stall Avoidance System for a Subsonic Axial Compressor
Schulze, R., Technische Univ., Germany; Hennecke, D. K., Technische Univ., Germany; Design Principles and Methods for Aircraft Gas Turbine Engines; February 1999, pp. 28-1 - 28-10; In English; See also 20000020789; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

A single-stage subsonic compressor was examined as a basis for an active stall avoidance system. The process of stall inception was investigated as well as the modes of unstable operation. On the basis of the experimental results, a sensor/actuator scheme was chosen for the control system. A simple and robust stall detection system has been developed and implemented on a real-time computer. The control system's capability of stabilizing the compressor was shown in first experiments. The experiments were analyzed in detail.
CASI
Turbocompressors; Stabilization; Control Systems Design; Rotating Stalls

20000020815 NASA Lewis Research Center, Cleveland, OH USA
Rotating Pip Detection and Stall Warning in High-Speed Compressors Using Structure Function
Bright, Michelle M., NASA Lewis Research Center, USA; Qammar, Helen, Akron Univ., USA; Vhora, Hanif, Akron Univ., USA;

Schaffer, Michael, Akron Univ., USA; Design Principles and Methods for Aircraft Gas Turbine Engines; February 1999, pp. 29-1 - 29-7; In English; See also 20000020789
Contract(s)/Grant(s): NSF CTS-95-02327; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

A statistic for both rotating pip and incipient stall detection, called Structure Function is introduced for use in high speed research compressor environments. Experimental studies on stall inception processes have long observed two types of pre-stall compressor activity. Presently there exist methods for indicating modal stall precursive events in the compressor. This is a first application of a new method to detect rotating pip activity prior to stall in research compressors. The algorithm requires a very short sample of data to distinguish pip activity prior to stall, and thus may be used in a real time application. Additionally, this Structure Function algorithm is also used as a single sensor stall warning method under a variety of operating conditions, including clean inlet conditions, radially and circumferentially distorted inlet conditions, and in examples of steady air injection along the casing, and controlled air injection conditions. Structure Function provides a potential advantage over linear spectral techniques and wavelet algorithms for stall detection due to the simplicity of the algorithm and because it does not rely on a priori knowledge of frequency content.
Author
Rotating Stalls; Turbocompressors; Fault Detection; Prediction Analysis Techniques

20000020816 Von Karman Inst. for Fluid Dynamics, Turbomachinery Dept., Rhode-Saint-Genese, Belgium
Turbomachinery Blade Design Using a Navier-Stokes Solver and Artificial Neural Network
Pierret, S., Von Karman Inst. for Fluid Dynamics, Belgium; VandenBraembussche, R. A., Von Karman Inst. for Fluid Dynamics, Belgium; Design Principles and Methods for Aircraft Gas Turbine Engines; February 1999, pp. 30-1 - 30-9; In English; See also 20000020789; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

This paper describes a knowledge-based method for the automated design of more efficient turbine blades. Two-dimensional blade sections, defined by Bezier curves as a function of 15 parameters, are first optimized by means of Simulated Annealing (SA) and an Artificial Neural Network (ANN). The later one is an approximate model (response surface) of the 2D Navier-Stokes solutions of previous designs stored in a database. Depending on the performance predicted by a Navier-Stokes analysis the procedure will be stopped or the design cycle will be repeated after the newly designed blade has been added to the database. This extended database allows a more reliable optimization of the blade at next iteration. This procedure results in a considerable speed-up of the design process by reducing both the interventions of the operator and the computational effort. It is also shown how such a method allows the design of more efficient blades while satisfying both the aerodynamic and mechanical constraints. In this paper, emphasis is put on the formulation of a new objective function and its validation by means of three different blade designs.
Author
Turbine Blades; Engine Design; Applications Programs (Computers); Neural Nets; Optimization; Simulated Annealing

20000020817 Societe Nationale d'Etude et de Construction de Moteurs d'Aviation, Turbine Aero and Cooling Dept., Moissy-Cramayel, France
Advanced CFD Tools for Multi-Stage Turbine Analysis
Liamis, N., Societe Nationale d'Etude et de Construction de Moteurs d'Aviation, France; Duboue, J.–M., Societe Nationale d'Etude et de Construction de Moteurs d'Aviation, France; Design Principles and Methods for Aircraft Gas Turbine Engines; February 1999, pp. 31-1 - 31-12; In English; See also 20000020789; Original contains color illustrations; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

The purpose of this contribution is to report on the aerodynamical performance calculations carried out around high and low pressure turbines. Two different turbine configurations are considered : a single stage high pressure turbine including rotor blade tip clearance effects and a four stage low pressure turbine. A multi-stage approach based on the ONERA-Snecma 3D Navier-Stokes code CANARI is used to investigate the turbine flow behavior. The computational results are compared with experimental data.
Author
Computational Fluid Dynamics; Axial Flow Turbines; Applications Programs (Computers); Performance Prediction

20000020818 Rolls-Royce Ltd., Turbine Engine Systems, Bristol, UK
Advanced Computational Fluid Dynamics in the Design of Military Turbines
Gwilliam, N. J., Rolls-Royce Ltd., UK; Kingston, T. R., Rolls-Royce Ltd., UK; Design Principles and Methods for Aircraft Gas Turbine Engines; February 1999, pp. 32-1 - 32-11; In English; See also 20000020789; Original contains color illustrations; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

Today's design of turbine blade challenges the designer to meet the demanding requirements of overall increase in engine performance - more power for the same weight, greater engine efficiency and fuel economy. This has resulted in designs to cater for higher blade loading and faster rotational speeds. to achieve this, highlift shroudless designs are being adopted. One of the greatest challenges to the aerodynamic designer is the design of such blading so that the additional losses incurred, shock losses, greater secondary flows and susceptability to tip clearance are minimised. to do so, it is essential to be able to carry out an accurate three-dimensional analysis of the flow within the stage. This is achieved using computational fluid dynamics. This paper aims to describe and evaluate some of the tools available at Rolls Royce plc. for the numerical simulation of turbine flows. It was generated as part of a study to analyse a 'datum' and 'highlift' HP (high pressure) turbine, so as to establish both where losses occurred, and which CFD (Computational Fluid Dynamics) codes could best analyse the blading.
Author
Computational Fluid Dynamics; Turbine Blades; Engine Design; Computerized Simulation; Applications Programs (Computers)

20000020819 Motoren- und Turbinen-Union G.m.b.H., Munich, Germany
Automatic Three-Dimensional Cyclic Crack Propagation Predictions With Finite Elements at the Design Stage of an Aircraft Engine
Dhondt, G., Motoren- und Turbinen-Union G.m.b.H., Germany; Design Principles and Methods for Aircraft Gas Turbine Engines; February 1999, pp. 33-1 - 33-8; In English; See also 20000020789; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

At MTU a method was devised to perform linear elastic three dimensional (3-D) mixed-mode cyclic crack propagation calculations with the finite element method (FE) in a fully automatic way. The core of the method consists of an algorithm to modify an existing mesh consisting of 20-node 3-D brick elements to accommodate an arbitrarily shaped crack. Starting from the initial crack, the mixed-mode stress intensity factor (K) distribution is determined along the crack front and a crack increment is calculated leading to a new crack shape. This procedure is repeated about every 100 cycles until the desired crack length has been reached. Use of the superelement technique allows to perform more than 100 iterations within 24 hours for a realistic engine component.
Author
Aircraft Engines; Crack Propagation; Finite Element Method; Engine Design; Engine Parts

20000020820 Imperial Coll. of Science Technology and Medicine, London, UK
Forced Response Predictions for a HP Turbine Rotor Blade
Vahdati, M., Imperial Coll. of Science Technology and Medicine, UK; Green, J., Rolls-Royce Ltd., UK; Marshall, J. G., Rolls-Royce Ltd., UK; Imregun, M., Imperial Coll. of Science Technology and Medicine, UK; Design Principles and Methods for Aircraft Gas Turbine Engines; February 1999, pp. 34-1 - 34-11; In English; See also 20000020789; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

This paper presents two different strategies for the prediction of blade vibration levels under forced response. The first strategy is an uncoupled approach where the wake forces on the blade are obtained via a linearized aerodynamic model and fed into a reduced structural model. The aeroelastic solution is then performed either in the frequency or the time domain. The second approach is an integrated non-linear analysis that considers a multi-stage multi-passage and that includes the flexibility of the rotor blades. The analysis is then conducted in the time domain using non-linear unsteady aerodynamics. A case study was conducted for a HP turbine stage with 36 stator and 92 rotor blades. The response levels to a 36 engine order excitation were predicted using both the linearized uncoupled and nonlinear integrated approaches and the findings were compared with available experimental data. Good overall agreement was reached for most of the cases studied.
Author
Turbine Blades; Forced Vibration; Aerodynamic Forces; Rotor Blades (Turbomachinery)

20000020821 Pennsylvania State Univ., Dept. of Aerospace Engineering, University Park, PA USA
Aero-Thermo-Structural Design Optimization of Internally Cooled Turbine Blades
Dulikravich, G. S., Pennsylvania State Univ., USA; Martin, T. J., Pennsylvania State Univ., USA; Dennis, B. H., Pennsylvania State Univ., USA; Lee, E., Pennsylvania State Univ., USA; Han, Z.–X., Pennsylvania State Univ., USA; Design Principles and Methods for Aircraft Gas Turbine Engines; February 1999, pp. 35-1 - 35-12; In English; See also 20000020789
Contract(s)/Grant(s): NAG3-1995; NSF DMI-95-22854; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

A set of robust and computationally affordable inverse shape design and automatic constrained optimization tools have been developed for the improved performance of internally cooled gas turbine blades. The design methods are applicable to the aerodynamics, heat transfer, and thermoelasticity aspects of the turbine blade. Maximum use of the existing proven disciplinary

analysis codes is possible with this design approach. Preliminary computational results demonstrate possibilities to design blades with minimized total pressure loss and maximized aerodynamic loading. At the same time, these blades are capable of sustaining significantly higher inlet hot gas temperatures while requiring remarkably lower coolant mass flow rates. These results suggest that it is possible to design internally cooled turbine blades that will cost less to manufacture, will have longer life span, and will perform as good, if not better than, film cooled turbine blades.
Author
Structural Design; Turbine Blades; Design Analysis; Gas Turbines; Computational Fluid Dynamics; Multidisciplinary Design Optimization

20000020822 Rolls-Royce Ltd., Turbine Research, Bristol, UK
The Benefits of a Rotating Rig for Research Into Advanced Turbine Cooling Systems
Davenport, R., Rolls-Royce Ltd., UK; Design Principles and Methods for Aircraft Gas Turbine Engines; February 1999, pp. 37-1 - 37-9; In English; See also 20000020789; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

Internal cooling of turbine blades is essential for efficient turbine engine performance and dictates the life of the component. Engine specific thrust and efficiency benefit from blade cooling although the use of cooling air imposes cycle penalties and can reduce aerodynamic efficiency. Cooling research aims to develop and validate design methods to give maximum cooling effectiveness for minimum cooling flow. The design methods need to be reliable reducing the risks in future projects thus helping to avoid in-service short falls and high maintenance costs. Current design methods have been almost exclusively derived from experiments performed using simplified cooling geometries without the influence of rotation, which is perfectly feasible for nozzle guide vane designs but sadly lacking for rotor designs. However, it is important to pursue both static and rotating experiments to establish the effects of rotation and to determine design rules that allow corrections to static experimental data. All the experimental data can be used to validate Computational Fluid Dynamics (CFD) modelling which has difficulty in predicting heat transfer levels in highly turbulent 3D flows.
Author
Computational Fluid Dynamics; Cooling Systems; Engine Design; Design Analysis

20000020823 NASA Lewis Research Center, Cleveland, OH USA
Simulation of Crack Propagation in Engine Rotating Components Under Variable Amplitude Loading
Bonacuse, P. J., Army Research Lab., USA; Ghosn, L. J., Case Western Reserve Univ., USA; Telesman, J., NASA Lewis Research Center, USA; Calomino, A. M., NASA Lewis Research Center, USA; Kantzos, P., Ohio Aerospace Inst., USA; Design Principles and Methods for Aircraft Gas Turbine Engines; February 1999, pp. 38-1 - 38-8; In English; See also 20000020789; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

The crack propagation life of tested specimens has been repeatedly shown to strongly depend on the loading history. Overloads and extended stress holds at temperature can either retard or accelerate the crack growth rate. Therefore, to accurately predict the crack propagation life of an actual component, it is essential to approximate the true loading history. In military rotorcraft engine applications, the loading profile (stress amplitudes, temperature, and number of excursions) can vary significantly depending on the type of mission flown. To accurately assess the durability of a fleet of engines, the crack propagation life distribution of a specific component should account for the variability in the missions performed (proportion of missions flown and sequence). In this report, analytical and experimental studies are described that calibrate/validate the crack propagation prediction capability for a disk alloy under variable amplitude loading. A crack closure based model was adopted to analytically predict the load interaction effects. Furthermore, a methodology has been developed to realistically simulate the actual mission mix loading on a fleet of engines over their lifetime. A sequence of missions is randomly selected and the number of repeats of each mission in the sequence is determined assuming a Poisson distributed random variable with a given mean occurrence rate. Multiple realizations of random mission histories are generated in this manner and are used to produce stress, temperature, and time points for fracture mechanics calculations. The result is a cumulative distribution of crack propagation lives for a given, life limiting, component location. This information can be used to determine a safe retirement life or inspection interval for the given location.
Author
Crack Propagation; Engine Parts; Computerized Simulation; Variable Amplitude Loading

20000020824 Oxford Univ., Dept. of Engineering Science, Oxford, UK
Theory for the Use of Foreign Gas in Simulating Film Cooling
Jones, T. V., Oxford Univ., UK; Design Principles and Methods for Aircraft Gas Turbine Engines; February 1999, pp. 39-1 - 39-8; In English; See also 20000020789; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

In the film cooling of turbines the coolant is significantly cooler than the freestream. Consequently the coolant is at a higher density and this plays an important role in determining the flowfield. In laboratory experiments with small temperature differences this density difference is simulated by using dense foreign gas. This paper analyses the effect of molecular properties on the thermal measurements so that they may be related to the cold air situation.
Author
Film Cooling; Computerized Simulation

20000020825 Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Inst. of Materials Research, Cologne, Germany
The Potential of Advanced Materials on Structural Design of Future Aircraft Engines
Kumpfert, J., Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Germany; Peters, M., Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Germany; Kaysser, W. A., Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Germany; Design Principles and Methods for Aircraft Gas Turbine Engines; February 1999, pp. 42-1 - 42-12; In English; See also 20000020789; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

For a gas turbine engine manufacturer the direct operating costs (DOC) of aircraft engines is primarily reduced by control of fuel costs, maintenance costs, and through weight savings. All aspects are strongly influenced by the materials technology available and can improve the component efficiency significantly. The recent development of conventional high temperature titanium alloys has demonstrated the in-service capabilities of conventional materials due to better understanding of microstructure/property relationships. Beyond these capabilities new light-weight materials as titanium aluminides and titanium matrix composites (TMCs) may improve engine performance significantly. In particular TMCs can improve compressor efficiency by enabling new compressor design not feasible with any other material used today. Increased turbine efficiency depends primarily on the gas turbine inlet temperature. to further increase the thrust-to-weight ratio and decrease the specific fuel consumption new aircraft engines will require gas turbine inlet temperatures well beyond 1600 C. Since new structural high temperature materials capable of service temperatures significantly above current high pressure turbine temperatures are not feasible in short-term other innovative technologies are required. This is in particular through the introduction of electron-beam physical vapor deposition (EB-PVD) thermal barrier coatings (TBCs). Reduced emissions and lower specific fuel consumption (SFQ) of next generation jet engines depend predominantly on new combustor design. Very low emission combustors require revolutionary materials as ceramic matrix composites (CMCs) to replace the metallic liner currently in use. The potential payoff, processing, and properties of conventional high temperature titanium alloys, titanium aluminides, TMCs, TBCs, and CMCs are highlighted regarding applications in aircraft engines.
Author
Structural Design; Aircraft Design; Aircraft Engines; Ceramic Matrix Composites

20000020826 Rolls-Royce Ltd., Performance Systems, Bristol, UK
Cycle-Match Engine Models Used in Functional Engine Design: An Overview
Horobin, Marcus S., Rolls-Royce Ltd., UK; Design Principles and Methods for Aircraft Gas Turbine Engines; February 1999, pp. 44-1 - 44-22; In English; See also 20000020789; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

The wider use of iterative thermodynamic (cycle-match) engine models across the functional design process offers many technical and organizational benefits which contribute to reduced risk in engine development programmes. The use of low and high order engine models for control-system design and validation is used to illustrate some of these advantages. The principles of the iterative technique are discussed with reference to the extra capabilities required of models used for control-system design and validation. Some related issues e.g. increased model capability, complexity and user-acceptability are also discussed.
Author
Engine Design; Thermodynamic Cycles; Functional Design Specifications; Design Analysis

20000020827 Kansas Univ., Aerospace Engineering Dept., Lawrence, KS USA
Smart Flow Control in Aircraft Engine Components and Component Interactions
Farokhi, S., Kansas Univ., USA; Design Principles and Methods for Aircraft Gas Turbine Engines; February 1999, pp. 45-1 - 45-11; In English; See also 20000020789; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

Adverse flow environments pose challenging design constraints in aircraft engine components and component interactions. Some examples of such flow environments are: steep pressure gradients, random and periodic unsteadiness, shock wave interactions and 3-D boundary layer separation. These adverse flow environments and interactions promote the growth of various kinds of instability waves inherent in gas turbine engines, e.g., vorticity wave, entropy wave and acoustic or pressure wave instabilities. A series of smart subsonic and supersonic flow controllers are presented with applications to the design of aircraft gas turbine engine components. They are on-demand vortex generators capable of injecting co- and counter-rotating streamwise

vortices in subsonic, transonic and supersonic flow. The strength and location of the vortex is a control variable and must be optimized via a closed-loop control algorithm. The subsonic smart Vortex Generator (VG) assumes a ramp-type geometry (similar to Wheeler vortex generators) and the smart supersonic VG is a tailored cavity with a movable flap concealing the cavity. The movable flap is actuated inward to expose the cavity to transonic or supersonic flow. The depth of the cavity is controlled via a closed-loop feedback control system which ties the strength of the vortex to the "desired" performance as measured by one or more sensors. Candidate cost functions are proposed in the optimization routine for each component in a gas turbine engine.
Author
Flow Characteristics; Aircraft Engines; Design Analysis; Aircraft Design

20000020828 Naval Air Systems Command, Propulsion and Power Engineering, Patuxent , MD USA
F/A-18 E/F Aircraft Engine (F414-GE-400) Design and Development Methodology
Burnes, Robert, Naval Air Systems Command, USA; Blottenberger, Don, Naval Air Systems Command, USA; Elliott, Michael, Naval Air Systems Command, USA; Design Principles and Methods for Aircraft Gas Turbine Engines; February 1999, pp. 46-1 - 46-12; In English; See also 20000020789; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

In the 1970's the USA Navy (USN) faced a dilemma. The F-4 Phantom and A-7 Corsair aircraft were aging rapidly and new threats were arising as technology advanced. to answer the call for a new attack fighter, the USN developed and deployed the F/A-18 aircraft. In 1987, the Secretary of Defense directed the USN to study advanced versions of the F/A-18 to face threats into the twenty-first century. This study resulted in the F/A-18 E/F. The F/A-18 E/F represents the next level in the evolution of the F/A-18 Attack Fighter. From the beginning, the objective has remained stable; to define an affordable system taking full advantage of the cost benefits associated with a derivative system without compromise of mission capabilities.
Derived from text
Aircraft Engines; Engine Design

20000020846 Defence Evaluation Research Agency, Combustion and Emissions Section, Farnborough, UK
Measurement and Prediction of NO and NO2 Emissions from Aero Engines
Foster, T. J., Defence Evaluation Research Agency, UK; Wilson, C. W., Defence Evaluation Research Agency, UK; Pourkashanian, M., Leeds Univ., UK; Williams, A., Leeds Univ., UK; Gas Turbine Engine Combustion, Emissions and Alternative Fuels; June 1999, pp. 19-1 - 19-9; In English; See also 20000020829; Original contains color illustrations; Copyright Waived; Avail: CASI; A02, Hardcopy; A06, Microfiche

Aircraft fitted with afterburner systems for increased thrust have been observed to have NOx emissions with a higher proportion of nitrogen dioxide (N02) than non-augmented aircraft. These emissions are generally characterised by a brown plume and has implications for aircraft visibility and stealth as well as environmental considerations. This paper describes the CFD modelling of NOx emissions from a modern afterburner system. A commercial CFD code, Fluent, was used to develop and solve a three dimensional model of a "burn then mix" afterburner system under investigation. A post processor package has been developed and was used to calculate both NO and NO2 concentrations. Four reheat settings were investigated; minimum, 25%, 50% and maximum reheat. For all conditions investigated the bulk of NOx emission was found in the core, stemming from the vitiated combustor air flow. NOx was also formed in the bypass stream, the production zone was found to be close to the fuel sprayers and flame stabiliser at minimum reheat, but moved downstream towards the exit nozzle as reheat power was increased. The model showed that for all the conditions under investigation, over 90% of the NOx produced in the reheat system was formed via the thermal-NO route. The model has been compared with centre-line traverse data measured at the exit nozzle of the engine on a sea-level static test bed. The predicted NOx emissions agreed quantitatively with the experimental measurements to within +/- 5%
Author
Afterburning; Nitrogen Dioxide; Nitrogen Oxides; Exhaust Emission; Plumes; Gas Turbine Engines; Three Dimensional Models

20000020847 Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Inst. of Propulsion Technology, Cologne, Germany
Influence of Engine Performance on Emission Characteristics
Doepelheuer, A., Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Germany; Lecht, M., Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Germany; Gas Turbine Engine Combustion, Emissions and Alternative Fuels; June 1999, pp. 20-1 - 20-12; In English; See also 20000020829; Copyright Waived; Avail: CASI; A03, Hardcopy; A06, Microfiche

This paper concentrates on the results of different investigations on aircraft engine emissions. In a first step semi-empirical emission correlation methods to predict the sum of nitric oxide and nitrogen dioxide (NOx), carbon monoxide (CO), hydrocarbons (HC) and soot are introduced. They all are of a "variable" reference type meaning, that published sea level static (SLS) measurements will be used as a reference. to calculate the amount of emissions for altitude operating conditions, the actual

parameters involved like the fuel flow (for the NOx correlation method), the reciprocal value of the combustor loading parameter (for the CO and HC correlation methods) and the combustor inlet temperature and pressure, the flame temperature and the equivalence ratio (for the soot correlation method) are set into relation to the respective reference ground values. The necessary internal engine parameters are received from a thermodynamic engine modelling program shortly described in this paper. Because of the fact, that the engine thermodynamic state is mainly determined by the thrust demand of the aircraft and the ambient conditions, not only engines, but also aircraft engine combinations on different flight missions had to be looked at. Therefore a flight performance module is presented, which allows - in combination with the engine modelling program and the emission calculation methods detailed simulations and investigations of flight missions on the entire route. As a result not only the effects of engine performance modes and parameters (like bypass ratio in combination with overall pressure ratio) but also the effects of ambient conditions (like wind and ambient temperature) and flight profile (like cruise altitude, step climb, take off weight and payload factor) on the fuel burned and the emissions produced by different engines and aircraft in use are investigated. Finally the results of a comparison between a subsonic and a supersonic mission and a comparison between a jet aircraft of the first generation and a modern type are given.
Author
Aircraft Engines; Exhaust Emission; Propulsion System Performance; Environment Effects; Pollution; Thermodynamics; Mathematical Models

20000020854 Defence Evaluation Research Agency, Propulsion Dept., Farnborough, UK
A Novel Technique for Predicting the Ignition Performance of an Aero Gas Turbine Combustion Chamber
Wilson, C. W., Defence Evaluation Research Agency, UK; Sheppard, C. G. W., Leeds Univ., UK; Low, H. C., Rolls-Royce Ltd., UK; Gas Turbine Engine Combustion, Emissions and Alternative Fuels; June 1999, pp. 29-1 - 29-12; In English; See also 20000020829; Original contains color illustrations; Copyright Waived; Avail: CASI; A03, Hardcopy; A06, Microfiche

The work reported in this report is directed towards improvements in the ignition of gas turbine combustors. Currently available design rules are incapable of predicting the improved performance obtained with different ignition systems or igniter placement. Work has been carried out to address the inadequacies, in the current ignition prediction techniques, using Computational Fluid Dynamics (CFD). A preliminary validation of the CFD ignition prediction technique was performed using ignition results from a fully annular research combustor. Qualitatively, the effect of igniter position, igniter type and combustor mass flow rate on ignition performance have been predicted, by inspection of the Karlovitz number encountered by a tracer, used to model a developing ignition kernel.
Author
Combustion Chambers; Ignition Systems; Gas Turbine Engines; Igniters; Performance Prediction

20000020929 Naval Postgraduate School, Monterey, CA USA
Analysis of the Tip Leakage Flow Field in an Axial Turbine
Anderson, C. S.; Jun. 1999; 189p; In English
Report No.(s): AD-A371278; No Copyright; Avail: CASI; A09, Hardcopy; A02, Microfiche

Comparisons of experimental laser-Doppler-velocimetry measurements using the Naval Postgraduate School cold-flow turbine test rig were made with 3D viscous computational fluid dynamics flow solutions. The turbine tested was the first stage of the Pratt and Whitney designed High Pressure Fuel Turbopump for the Space Shuttle Main Engine. The laser anemometer was modified to incorporate a field stop, which acted as a spatial filter to limit reception of undesired blade reflections. The laser measurements were made in the endwall region of the test turbine, at three axial locations, and at three radial depths. For each location, absolute flow angle, axial and tangential velocity ratios, turbulence intensities and correlation coefficients were measured. The computational effort encompassed modeling a single blade passage of both the stator and the rotor and computing flow solutions of the stage using NASA software. Exit plane and endwall flow property profiles showed good agreement when compared with experimental data.
DTIC
Axial Flow Turbines; Leakage; Flow Distribution; Data Acquisition; Three Dimensional Flow

20000021103 Princeton Univ., Dept. of Material and Aerospace Engineering, NJ USA
Air Force Research in Aero Propulsion Technology *Final Report, 1 Sep. 1989 - 30 Nov. 1998*
Law, Chung K.; Nov. 30, 1998; 6p; In English
Contract(s)/Grant(s): AF-AFOSR-0473-89; AF Proj. 2308
Report No.(s): AD-A371388; AFRL-SR-BL-TR-99-0256; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

The program on Air Force Research on Aero Propulsion Technology (AFRAPT) was conceived by the Air Force Office of Scientific Research, with the support of a consortium of universities, as a means of exposing graduate students to aeropropulsion technology as part of their graduate study experience. The students typically were in residence during the academic year, and were employed by one of the gas turbine companies during summer. During the period of 1989 to 1998, Princeton University actively participated in this program. A total of four students received M.S.E. degrees and seven students received Ph. D. degrees, with either total or partial support from AFRAPT.
DTIC
Propulsion; Aircraft Engines

20000021567 NASA Glenn Research Center, Cleveland, OH USA
Experimental and Numerical Investigation of Losses in Low-Pressure Turbine Blade Rows
Dorney, Daniel J., NASA Glenn Research Center, USA; Lake, James P., NASA Glenn Research Center, USA; King, Paul I., NASA Glenn Research Center, USA; Ashpis, David E., NASA Glenn Research Center, USA; January 2000; 18p; In English; 38th; 38th Aerospace Science Meeting, 10-13 Jan. 2000, Reno, NV, USA; Original contains color illustrations
Contract(s)/Grant(s): NCC3-645; RTOP 523-26-33
Report No.(s): NASA/TM-2000-209910; NAS 1.15:209910; AIAA Paper 2000-0737; E-12137; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Experimental data and numerical simulations of low-pressure turbines have shown that unsteady blade row interactions and separation can have a significant impact on the turbine efficiency. Measured turbine efficiencies at takeoff can be as much as two points higher than those at cruise conditions. Several recent studies have revealed that the performance of low-pressure turbine blades is a strong function of the Reynolds number. In the current investigation, experiments and simulations have been performed to study the behavior of a low-pressure turbine blade at several Reynolds numbers. Both the predicted and experimental results indicate increased cascade losses as the Reynolds number is reduced to the values associated with aircraft cruise conditions. In addition, both sets of data show that tripping the boundary layer helps reduce the losses at lower Reynolds numbers. Overall, the predicted aerodynamic and performance results exhibit fair agreement with experimental data.
Author
Turbine Blades; Losses; Aircraft Wakes

20000024990 Lee (Ed) and Associates, San Ramon, CA USA
[Component and System Level of the FASTRAC Engine] ***Final Report, 20 Jul. - 31 Dec. 1999***
1999; 4p; In English
Contract(s)/Grant(s): NASA Order H-31405-D; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

The primary activities of Lee & Associates during the period 7/20/99 to 12/31/99 as specified in the referenced Purchase Order has been in direct support of the Advanced Space Technology Program OfFice's Core Propulsion Project. An independent review to assess the program readiness to conduct component and system level testing of the FASTRAC Engine and to proceed into Fabrication has been provided. This was accomplished through the identification of program weaknesses and potential failure areas and where applicable recommended solutions were suggested to the Program Office that would mitigate technical and program risk. The approach taken to satisfy the objectives has been for the contractor to provide a team of experts with relevant experience from past programs and a strong background of experience in the fields critical to the success of the program. The team participated in Test Planning, Test Readiness Reviews for system testing at Stennis Space Center, Anomaly Resolution Reviews, an Operations Audit, and data analysis. This approach worked well in satisfying the objectives and providing the Project Office with valuable information in real time and through monthly reports. During the month of December 1999 the primary effort involved the participation in anomaly resolution and the detailed review of the data from the final H3 and H4 test series performed on the FASTRAC engine in the b-2 Horizontal Test Facility at Stennis. The more significant findings and recommendations from this review are presented in this report.
Derived from text
Aerospace Engineering; Rocket Engines; Propulsion

20000025301 NASA Glenn Research Center, Cleveland, OH USA
Performance and Durability of High Temperature Foil Air Bearings for Oil-Free Turbomachinery
DellaCorte, C., NASA Glenn Research Center, USA; Valco, M. J., Army Research Lab., USA; Radil, K. C., Army Research Lab., USA; Heshmat, H., Mohawk Innovative Technology, Inc., USA; November 1999; 20p; In English, 7-11 May 2000, Nashville, TN, USA; Sponsored by Society of Tribologists and Lubrication Engineers, USA
Contract(s)/Grant(s): RTOP 523-22-13

Report No.(s): NASA/TM-1999-209187; E-11697; NAS 1.15:209187; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The performance and durability of advanced, high temperature foil air bearings are evaluated under a wide range (10 to 50 kPa) of loads at temperatures from 25 to 650 C. The bearings are made from uncoated nickel based superalloy foils. The foil surface experiences sliding contact with the shaft during initial start/stop operation. to reduce friction and wear, the solid lubricant coating, PS304, is applied to the shaft by plasma spraying. PS304 is a NiCr based Cr2O3 coating with silver and barium fluoride/calcium fluoride solid lubricant additions. The results show that the bearings provide lives well in excess of 30,000 cycles under all of the conditions tested. Several bearings exhibited lives in excess of 100,000 cycles. Wear is a linear function of the bearing load. The excellent performance measured in this study suggests that these bearings and the PS304 coating are well suited for advanced high temperature, oil-free turbomachinery applications.

Author

Foil Bearings; Turbomachinery; Metal Foils

20000025390 NASA Lewis Research Center, Cleveland, OH USA

Comparison Analysis Between Nevada and TSS Using a Jet Engine Exhaust Nozzle Test Rig

Baumeister, Joseph F., NASA Lewis Research Center, USA; Yuko, James R., NASA Lewis Research Center, USA; Ninth Thermal and Fluids Analysis Workshop Proceedings; November 1999, pp. 49-67; In English; See also 20000025387; No Copyright; Avail: CASI; A03, Hardcopy; A03, Microfiche

Thermal analysis in both simple and complex models can require calculating the propagation of radiant energy to and from multiple surfaces. This can be accomplished through simple estimation techniques or complex computationally intense computer modeling simulations. Currently there are a variety of computer analysis techniques used to simulate the propagation of radiant energy, each having advantages and disadvantages. The major objective of this effort was to compare two ray tracing radiation propagation analysis programs (NEVADA and TSS) Net Energy Verification and Determination Analyzer and Thermal Synthesizer System with experimental data. Results from a non-flowing, electrically heated test rig was used to verify the calculated radiant energy propagation from a nozzle geometry that represents an aircraft propulsion nozzle system. In general the programs produced comparable overall results, and results slightly higher then the experimental data. Upon inspection of individual radiation interchange factors, differences were evident and would have been magnified if a more radical model temperature profile was analyzed. Bidirectional reflectivity data (BRDF) was not used do to modeling limitations in TSS. For code comparison purposes, this nozzle geometry represents only one case for one set of analysis conditions. Since each computer code has advantages and disadvantages bases on scope, requirements, and desired accuracy, the usefulness of this single case study may be limiting.

Author

Jet Engines; Exhaust Nozzles; Engine Tests; Thermal Analysis; Synthesizers; Applications Programs (Computers); Ray Tracing

08
AIRCRAFT STABILITY AND CONTROL

Includes flight dynamics, aircraft handling qualities; piloting; flight controls; and autopilots.

20000021116 Natal Univ., Dept. of Electrical Engineering, Durban, South Africa

International Symposium on Quantitative Feedback Theory and Robust Frequency Domain Methods

Boje, Edward, Editor; Eitelberg, Eduard, Editor; Aug. 27, 1999; 249p; In English; Quantitative Feedback Theory and Robust Frequency Domain Methods, 26-27 Aug. 1999, Durban, South Africa

Report No.(s): AD-A368926; EOARD-CSP-99-5011; ISBN 1-86840-330-0; No Copyright; Avail: CASI; A03, Microfiche; A11, Hardcopy

The Final Proceedings for 1999 Quantitative Feedback Theory (QFT) Symposium, 27 August 1999 - 28 August 1999. This is an interdisciplinary conference. Topics include: Quantitative Feedback Theory and Robust Frequency Domain Methods.

DTIC

Frequency Domain Analysis; Conferences; Control Theory

20000021227 Lockheed Martin Engineering and Sciences Co., Hampton, VA USA

Cg/Stability Map for the Reference H Cycle 3 Supersonic Transport Concept Along the High Speed Research Baseline Mission Profile

Giesy, Daniel P., Lockheed Martin Engineering and Sciences Co., USA; Christhilf, David M., Lockheed Martin Engineering and

Sciences Co., USA; December 1999; 38p; In English
Contract(s)/Grant(s): NAS1-96014; RTOP 537-07-24-21
Report No.(s): NASA/CR-1999-209527; NAS 1.26:209527; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A comparison is made between the results of trimming a High Speed Civil Transport (HSCT) concept along a reference mission profile using two trim modes. One mode uses the stabilator. The other mode uses fore and aft placement of the center of gravity. A comparison is make of the throttle settings (cruise segments) or the total acceleration (ascent and descent segments) and of the drag coefficient. The comparative stability of trimming using the two modes is also assessed by comparing the stability margins and the placement of the lateral and longitudinal eigenvalues.
Author
Center of Gravity; Lateral Stability; Longitudinal Stability; Supersonic Transports; High Speed; Civil Aviation

20000023160 NASA Langley Research Center, Hampton, VA USA
High Speed Civil Transport Aircraft Simulation: Reference-H Cycle 1, MATLAB Implementation
Sotack, Robert A., George Washington Univ., USA; Chowdhry, Rajiv S., Lockheed Martin Engineering and Sciences Co., USA; Buttrill, Carey S., NASA Langley Research Center, USA; December 1999; 82p; In English
Contract(s)/Grant(s): RTOP 537-07-24-01
Report No.(s): NASA/TM-1999-209530; NAS 1.15:209530; E-17900; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

The mathematical model and associated code to simulate a high speed civil transport aircraft - the Boeing Reference H configuration - are described. The simulation was constructed in support of advanced control law research. In addition to providing time histories of the dynamic response, the code includes the capabilities for calculating trim solutions and for generating linear models. The simulation relies on the nonlinear, six-degree-of-freedom equations which govern the motion of a rigid aircraft in atmospheric flight. The 1962 Standard Atmosphere Tables are used along with a turbulence model to simulate the Earth atmosphere. The aircraft model has three parts - an aerodynamic model, an engine model, and a mass model. These models use the data from the Boeing Reference H cycle 1 simulation data base. Models for the actuator dynamics, landing gear, and flight control system are not included in this aircraft model. Dynamic responses generated by the nonlinear simulation are presented and compared with results generated from alternate simulations at Boeing Commercial Aircraft Company and NASA Langley Research Center. Also, dynamic responses generated using linear models are presented and compared with dynamic responses generated using the nonlinear simulation.
Author
Supersonic Transports; Transport Aircraft; Boeing Aircraft; Civil Aviation; Aircraft Models; Mathematical Models; Computerized Simulation; Algorithms

20000023185 Old Dominion Univ., Dept. of Aerospace Engineering, Norfolk, VA USA
Investigation of Inner Loop Flight Control Strategies for High-Speed Research
Newman, Brett, Old Dominion Univ., USA; Kassem, Ayman, Old Dominion Univ., USA; December 1999; 172p; In English
Contract(s)/Grant(s): NAS1-19858; RTOP 537-07-24-01
Report No.(s): NASA/CR-1999-209522; NAS 1.26:209522; No Copyright; Avail: CASI; A08, Hardcopy; A02, Microfiche

This report describes the activities and findings conducted under contract NAS1-19858 with NASA Langley Research Center. Subject matter is the investigation of suitable flight control design methodologies and solutions for large, flexible high-speed vehicles. Specifically, methodologies are to address the inner control loops used for stabilization and augmentation of a highly coupled airframe system possibly involving rigid-body motion, structural vibrations, unsteady aerodynamics, and actuator dynamics. Techniques considered in this body of work are primarily conventional-based, and the vehicle of interest is the High-Speed Civil Transport (HSCT). Major findings include 1) current aeroelastic vehicle modeling procedures require further emphasis and refinement, 2) traditional and nontraditional inner loop flight control strategies employing a single feedback loop do not appear sufficient for highly flexible HSCT class vehicles, 3) inner loop flight control systems will, in all likelihood, require multiple interacting feedback loops, and 4) Ref. H HSCT configuration presents major challenges to designing acceptable closed-loop flight dynamics.
Author
Feedback Control; Flight Control; Supersonic Transports; Control Systems Design

20000024880 Instituto Superior Tecnico, Dept. of Mechanical Engineering, Lisbon Portugal
Application of Adaptive Materials in Flutter Suppression of Aircraft Structures *Final Report, Oct. 1998 - Oct. 1999*
Suleman, Afzal; Oct. 1999; 62p; In English

Contract(s)/Grant(s): F61775-98-W-E125
Report No.(s): AD-A372473; EOARD-SPC-98-4082; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

This report results from a contract tasking Instituto Superior Tecnico as follows: The contractor will investigate the application of integrated adaptive actuators to the problem of flutter control in aircraft structures. The research will focus on electro-mechanical finite element models (FEM) their application to simulations of flutter on airframe components.
DTIC

Aircraft Structures; Flutter Analysis; Dynamic Structural Analysis; Mathematical Models; Adaptive Control

20000025077 NASA Langley Research Center, Hampton, VA USA
A Qualitative Piloted Evaluation of the Tupolev TU-144 Supersonic Transport
Rivers, Robert A., NASA Langley Research Center, USA; Jackson, E. Bruce, NASA Langley Research Center, USA; Fullerton, C. Gordon, NASA Dryden Flight Research Center, USA; Cox, Timothy H., NASA Dryden Flight Research Center, USA; Princen, Norman H., Boeing Co., USA; February 2000; 47p; In English; Original contains color illustrations
Contract(s)/Grant(s): RTOP 537-08-23
Report No.(s): NASA/TM-2000-209850; NAS 1.15:209850; L-17945; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Two U.S. research pilots evaluated the Tupolev TU-144 supersonic transport aircraft on three dedicated flights: one subsonic and two supersonic profiles. The flight profiles and maneuvers were developed jointly by Tupolev and U.S. engineers. The vehicle was found to have unique operational and flight characteristics that serve as lessons for designers of future supersonic transport aircraft. Vehicle subsystems and observed characteristics are described as are flight test planning and ground monitoring facilities. Maneuver descriptions and extended pilot narratives for each flight are included as appendices.
Author

Flight Characteristics; Flight Tests; Supersonic Transports; TU-144 Aircraft; Proving

20000025202 Lockheed Martin Engineering and Sciences Co., Hampton, VA USA
Modeling the High Speed Research Cycle 2B Longitudinal Aerodynamic Database Using Multivariate Orthogonal Functions
Morelli, E. A., Lockheed Martin Engineering and Sciences Co., USA; Proffitt, M. S., Lockheed Martin Engineering and Sciences Co., USA; December 1999; 86p; In English
Contract(s)/Grant(s): NAS1-19000; RTOP 537-07-24
Report No.(s): NASA/CR-1999-209525; NAS 1.26:209525; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

The data for longitudinal non-dimensional, aerodynamic coefficients in the High Speed Research Cycle 2B aerodynamic database were modeled using polynomial expressions identified with an orthogonal function modeling technique. The discrepancy between the tabular aerodynamic data and the polynomial models was tested and shown to be less than 15 percent for drag, lift, and pitching moment coefficients over the entire flight envelope. Most of this discrepancy was traced to smoothing local measurement noise and to the omission of mass case 5 data in the modeling process. A simulation check case showed that the polynomial models provided a compact and accurate representation of the nonlinear aerodynamic dependencies contained in the HSR Cycle 2B tabular aerodynamic database.
Author

Models; High Speed; Civil Aviation; Aerodynamic Coefficients; Polynomials; Orthogonal Functions; Tabulation Processes; Wind Tunnel Tests

20000025210 NASA Langley Research Center, Hampton, VA USA
Subsonic and Transonic Dynamic Stability Characteristics of the X-33
Tomaek, Deborah M., NASA Langley Research Center, USA; Boyden, Richmond P., NASA Langley Research Center, USA; [2000]; 20p; In English; 38th; 38th Aerospace Sciences Meeting, 10-13 Jan. 2000, Reno, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Report No.(s): AIAA Paper 2000-0266; Copyright Waived; Avail: CASI; A03, Hardcopy; A01, Microfiche

Dynamic stability testing was conducted on a 2.5% scale model of the X-33 technology demonstrator suborbital flight-test vehicle. This testing was conducted at the NASA Langley Research Center (LaRC) 16-Foot Transonic Wind Tunnel with the LaRC High-Speed Dynamic Stability system. Forced oscillation data were acquired for various configurations over a Mach number range of 0.3 to 1.15 measuring pitch, roll and yaw damping, as well as the normal force due to pitch rate and the cross derivatives. The test angle of attack range was from -2 to 24 degrees, except for those cases where load constraints limited the higher angles of attack at the higher Mach numbers. A variety of model configurations with and without control surfaces were

employed, including a "body alone" configuration. Stable pitch damping is exhibited for the baseline configuration throughout the angle of attack range for Mach numbers 0.3, 0.8, and 1.15. Stable pitch damping is present for Mach numbers 0.9 and 0.6 with the exception of angles 2 and 16 degrees, respectively. Constant and stable roll damping were present for the baseline configuration over the range of Mach numbers up to an angle of attack of 16 degrees. The yaw damping for the baseline is somewhat stable and constant for the angle of attack range from -2 to 8 degrees, with the exception of Mach numbers 0.6 and 0.8. Yaw damping becomes highly unstable for all Mach numbers at angles of attack greater than 8 degrees.
Author
Dynamic Stability; Mach Number; Stability; Subsonic Speed; X-33 Reusable Launch Vehicle; Wind Tunnel Tests; Aerodynamic Characteristics; Oscillations; Aerodynamic Stability; Spacecraft Stability

20000025233 NASA Langley Research Center, Hampton, VA USA
Subsonic and Transonic Dynamic Stability Characteristics of the X-33
Tomek, Deborah M., NASA Langley Research Center, USA; Boyden, Richmond P., NASA Langley Research Center, USA; [2000]; 20p; In English; 38th; 38th Aerospace Sciences Meeting, 10-13 Jan. 2000, Reno, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Report No.(s): AIAA Paper 2000-0266; Copyright Waived; Avail: CASI; A03, Hardcopy; A01, Microfiche

Dynamic stability testing was conducted on a 2.5% scale model of the X-33 technology demonstrator suborbital flight-test vehicle. This testing was conducted at the NASA Langley Research Center (LaRC) 16-Foot Transonic Wind Tunnel with the LaRC High-Speed Dynamic Stability system. Forced oscillation data were acquired for various configurations over a Mach number range of 0.3 to 1.15 measuring pitch, roll and yaw damping, as well as the normal force due to pitch rate and the cross derivatives. The test angle of attack range was from -2 to 24 degrees, except for those cases where load constraints limited the higher angles of attack at the higher Mach numbers. A variety of model configurations with and without control surfaces were employed, including a "body alone" configuration. Stable pitch damping is exhibited for the baseline configuration throughout the angle of attack range for Mach numbers 0.3, 0.8, and 1.15. Stable pitch damping is present for Mach numbers 0.9 and 0.6 with the exception of angles 2 and 16 degrees, respectively. Constant and stable roll damping were present for the baseline configuration over the range of Mach numbers up to an angle of attack of 16 degrees. The yaw damping for the baseline is somewhat stable and constant for the angle of attack range from -2 to 8 degrees, with the exception of Mach numbers 0.6 and 0.8. Yaw damping becomes highly unstable for all Mach numbers at angles of attack greater than 8 degrees.
Author
Dynamic Stability; Wind Tunnel Tests; Wind Tunnel Stability Tests

20000025434 NASA Langley Research Center, Hampton, VA USA
Reference H Piloted Assessment (LaRC.1) Pilot Briefing Guide
Jackson, E. Bruce, NASA Langley Research Center, USA; Raney, David L., NASA Langley Research Center, USA; Hahne, David E., NASA Langley Research Center, USA; Derry, Stephen D., NASA Langley Research Center, USA; Glaab, Louis J., Lockheed Martin Engineering and Sciences Co., USA; December 1999; 102p; In English
Contract(s)/Grant(s): RTOP 537-08-23-21
Report No.(s): NASA/TM-1999-209533; L-17903; NAS 1.15:209533; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

This document describes the purpose of and method by which an assessment of the Boeing Reference H High-Speed Civil Transport design was evaluated in the NASA Langley Research Center's Visual/Motion Simulator in January 1997. Six pilots were invited to perform approximately 60 different Mission Task Elements that represent most normal and emergency flight operations of concern to the High Speed Research program. The Reference H design represents a candidate configuration for a High-Speed Civil Transport, a second generation supersonic civilian transport aircraft. The High-Speed Civil Transport is intended to be economically sound and environmentally safe while carrying passengers and cargo at supersonic speeds with a trans-Pacific range. This simulation study was designated "LaRC. 1" for the purposes of planning, scheduling and reporting within the Guidance and Flight Controls super-element of the High-Speed Research program. The study was based upon Cycle 3 release of the Reference H simulation model.
Author
Civil Aviation; Flight Control; Flight Operations; Motion Simulators; Evaluation

09
RESEARCH AND SUPPORT FACILITIES (AIR)

Includes airports, runways, hangars, and aircraft repair and overhaul facilities; wind tunnels, water tunnels, and shock tubes; flight simulators; and aircraft engine test stands. Also includes airport ground equipment and systems.

20000021001 Federal Aviation Administration, General Aviation and Vertical Flight Program Office, Washington, DC USA
FAA Helicopter/Vertiport Lighting Conference: Proceedings *Final Report*
Smith, Robert D., Federal Aviation Administration, USA; Nov. 1999; 271p; In English
Report No.(s): AD-A370873; DOT/FAA/ND-99/1; No Copyright; Avail: CASI; A03, Microfiche; A12, Hardcopy

As the vertical flight industry moves into instrument flight rules (IFR) operations at heliports, it has become apparent to both FAA and the users that there is research and development to be done on heliport lighting. With the civil tiltrotor now in production, there is also work to be done on vertiport lighting. The lighting industry has developed a variety of technologies that appear promising as candidate heliport and vertiport lighting components. Still, there are many questions still to be answered. For example: Which technologies can best provide the different visual cues needed by the pilot? What lighting configurations are most effective in various scenarios? to what criteria should some of these lights be certificated? Some of these and other questions will be answered by the marketplace. Other questions should be addressed via research and development. In looking at the heliport lighting research done by the FAA over the last decade and the resulting advisory circular guidance, it is clear that there are many more questions than answers. to answer these questions would require much more in the way of resources than what is likely to be available in the near future. With this in mind, the FAA sought the advice of the aviation community on how we could best proceed. A two-day technical conference was the mechanism used. This report documents the proceedings of this conference.
DTIC
Helicopters; Instrument Flight Rules; Conferences; Illuminating; Heliports

20000021500 NASA Langley Research Center, Hampton,VA USA
An Experimental Investigation of Damaged Arresting Gear Tapes for the Langley Aircraft Landing Dynamics Facility
Mason, Angela J., NASA Langley Research Center, USA; December 1999; 25p; In English
Report No.(s): NASA/TM-1999-209839; NAS 1.15:209839; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

An experimental investigation was performed on damaged arresting gear tapes at the Langley Aircraft Landing Dynamics Facility. The arrestment system uses five pairs of tapes to bring the test carriage to a halt. The procedure used to determine when to replace the tapes consists of a close evaluation of each of the 10 tapes after each run. During this evaluation, each tape is examined thoroughly and any damage observed on the tape is recorded. If the damaged tape does not pass the inspection, the tape is replaced with a new one. For the past 13 years, the most commonly seen damage types are edge fray damage and transverse damage. Tests were conducted to determine the maximum tensile strength of a damaged arresting gear tape specimen. The data indicate that tapes exhibiting transverse damage can withstand higher loads than tapes with edge fray damage.
NASA
Arresting Gear; Tapes; Aircraft Landing

20000024882 Defence Science and Technology Organisation, Aeronautical and Maritime research Lab., Melbourne, Australia
A New Data Acquisition System for the AMRL Low Speed Wind Tunnel
Holland, Owen; Lam, Stephen; Link, Yoel; Nov. 1999; 29p; In English
Report No.(s): AD-A372477; DSTO-TR-0896; DODA-AR-011-129; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The data acquisition system in the Low Speed Wind Tunnel at the Aeronautical and Maritime Research Laboratory was recently upgraded. The MicroVAX II host computer was replaced by a Digital AlphaServer 400 running Digital UNIX, and the Bi-directional Parallel Interface data bus was replaced by ethernet and fast serial communication. The upgrade provides a system which is easier to use; includes a graphical user interface; provides a communication bus based on standard communication protocols, which achieves higher data transfer rates; is far more reliable and easy to maintain; and the system is more flexible than previous versions.
DTIC
Wind Tunnel Tests; Low Speed Wind Tunnels; Data Acquisition; Protocol (Computers)

20000025211 NASA Langley Research Center, Hampton, VA USA
Rapid Model Fabrication and Testing for Aerospace Vehicles
Buck, Gregory M., NASA Langley Research Center, USA; 2000; 20p; In English; 38th; Aerospace Sciences, 10-13 Jan. 2000,

Reno, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Report No.(s): AIAA Paper 2000-0826; Copyright Waived; Avail: CASI; A03, Hardcopy; A01, Microfiche

Advanced methods for rapid fabrication and instrumentation of hypersonic wind tunnel models are being developed and evaluated at NASA Langley Research Center. Rapid aeroheating model fabrication and measurement techniques using investment casting of ceramic test models and thermographic phosphors are reviewed. More accurate model casting techniques for fabrication of benchmark metal and ceramic test models are being developed using a combination of rapid prototype patterns and investment casting. White light optical scanning is used for coordinate measurements to evaluate the fabrication process and verify model accuracy to +/- 0.002 inches. Higher-temperature (is less than 210C) luminescent coatings are also being developed for simultaneous pressure and temperature mapping, providing global pressure as well as global aeroheating measurements. Together these techniques will provide a more rapid and complete experimental aerodynamic and aerothermodynamic database for future aerospace vehicles.

Author

Fabrication; Hypersonic Wind Tunnels; Wind Tunnel Models; Wind Tunnel Tests; Aerospace Vehicles

20000026824 National Aerospace Lab., Tokyo Japan

Development of the Job Scheduler for the Numerical Wind Tunnel

Suematu, K.; May 1999; 18p; In Japanese; Portions of this document are not fully legible
Report No.(s): PB2000-102565; NAL-TR-1383; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The Numerical Wind Tunnel, NWT is a CFD-oriented vector parallel computer system with distributed memory. We developed a job scheduler to utilize the NWT effectively and put it into operation in October 1994. Since then, we have added various functions to the job scheduler to enhance the manageability of the NWT. It now achieves effective use of the processing elements (PE's) and execute tasks with a suitable turn-around time. This paper reports the functions and availability of the job scheduler for NWT use.

NTIS

Wind Tunnels; Computational Fluid Dynamics; Scheduling; Sequencing; Tasks

10
ASTRONAUTICS (GENERAL)

Includes general research topics related to space flight and manned and unmanned space vehicles, platforms or objects launched into, or assembled in, outer space; and related components and equipment. Also includes manufacturing and maintenance of such vehicles or platforms.

20000020690 NASA Glenn Research Center, Cleveland, OH USA

Overview of the HSR Propulsion Program

Peddie, Catherine, NASA Glenn Research Center, USA; 1998 NASA Seal/Secondary Air System Workshop; July 1999; Volume 1, pp. 1-27; In English; No Copyright; Avail: CASI; A03, Hardcopy; A04, Microfiche

This paper presents a general overview of the High Speed Research Propulsion Program in viewgraph form. The goals of the program are: 1) to reduce the travel time to the Far East and Europe by 50 percent within 20 years, and do so at today's subsonic ticket prices; 2) Invigorate the general aviation industry, delivering 10,000 aircraft annually within 10 years, and 20,000 aircraft annually within 20 years; and 3) Provide next-generation design tools and experimental aircraft to increase design confidence, and cut the development cycle time for aircraft in half.

CASI

General Overviews; High Speed; Aircraft Industry; Civil Aviation; Propulsion System Performance

20000020710 NASA Johnson Space Center, Houston, TX USA

Thermal Protection System Design and Development for the X-38

Kowal, T. John, NASA Johnson Space Center, USA; 1998 NASA Seal/Secondary Air System Workshop; July 1999; Volume 1, pp. 397-431; In English; No Copyright; Avail: CASI; A03, Hardcopy; A04, Microfiche

The purpose of the X-38 program is to greatly reduce the costs and schedule for the development of Crew Return Vehicles (CRV's) and Crew Transfer Vehicles (CTV's) through the use of the rapid development methodology associated with an X-project (Ground Testing, Atmospheric Testing and Space Flight Testing).

Derived from text

Thermal Protection; Systems Engineering; X-38 Crew Return Vehicle; Aerodynamic Configurations

20000020774 NASA Kennedy Space Center, Cocoa Beach, FL USA
STS-96 Crew Training, Mission Animation, Crew Interviews, STARSHINE, Discovery Rollout and Repair of Hail Damage
May 21, 1999; In English; Videotape: 1 hr. 5 min playing time, in color, with sound
Report No.(s): NONP-NASA-VT-2000008128; No Copyright; Avail: CASI; B04, Videotape-Beta; V04, Videotape-VHS

Live footage shows the crewmembers of STS-96, Commander Kent V. Rominger, Pilot Rick D. Husband, Mission Specialists Ellen Ochoa, Tamara E. Jernigan, Daniel T. Barry, Julie Payette and Valery Ivanovich Tokarev during various training activities. Scenes include astronaut suit-up, EVA training in the Virtual Reality Lab, Orbiter space vision training, bailout training, and crew photo session. Footage also shows individual crew interviews, repair activities to the external fuel tank, and Discovery's return to the launch pad. The engineers are seen sanding, bending, and painting the foam used in repairing the tank. An animation of the deployment of the STARSHINE satellite, International Space Station, and the STS-96 Mission is presented. Footage shows the students from Edgar Allen Poe Middle School sanding, polishing, and inspecting the mirrors for the STARSHINE satellite. Live footage also includes students from St. Michael the Archangel School wearing bunny suits and entering the clean room at Goddard Space Flight Center.

CASI

Astronaut Training; Training Simulators; Flight Simulation; Flight Training; Ejection Training; Bailout; Virtual Reality; Computerized Simulation; Extravehicular Activity; International Space Station

20000020788 NASA Kennedy Space Center, Cocoa Beach, FL USA
STS-96 TCDT Crew Arrival
Apr. 28, 1999; In English; Videotape: 9 min. 15 sec. playing time, in color, with sound
Report No.(s): NONP-NASA-VT-2000010632; No Copyright; Avail: CASI; B01, Videotape-Beta; V01, Videotape-VHS

Live footage shows the crewmembers of STS-96, Commander Kent V. Rominger, Pilot Rick D. Husband, Missions Specialists Ellen Ochoa, Tamara E. Jernigan, Daniel T. Barry, Julie Payette and Valery Ivanovich Tokarev, arriving at the Shuttle Landing Facility in T-38 aircraft for Terminal Countdown Demonstration Test (TCDT) activities. Rominger speaks briefly to introduce the other crewmembers and their designated responsibilities.

CASI

Crew Procedures (Preflight); Astronaut Training; T-38 Aircraft; Arrivals; Landing

20000021102 NASA Kennedy Space Center, Cocoa Beach, FL USA
Delta Fuse 2nd Stage Erection at Launch Complex 17A
Jun. 07, 1999; In English; Videotape: 4 min. 50 sec. playing time, in color, with sound
Report No.(s): NONP-NASA-VT-2000010633; KSC99-90131; No Copyright; Avail: CASI; B01, Videotape-Beta; V01, Videotape-VHS

Live footage shows workers removing the protective covering from the second stage fuse. Scene shows the lifting to the fuse onto the launch complex.

CASI

Construction; Aircraft Production; Production Engineering

20000025183 NASA Kennedy Space Center, Cocoa Beach, FL USA
STS-99 Crew departs SLF after TCDT
Jan. 17, 2000; In English; Videotape: 7 min. playing time, in color, with sound
Report No.(s): KSC-00013; NONP-NASA-VT-2000027984; No Copyright; Avail: CASI; B01, Videotape-Beta; V01, Videotape-VHS

The primary objective of the STS-99 mission was to complete high resolution mapping of large sections of the Earth's surface using the Shuttle Radar Topography Mission (SRTM), a specially modified radar system. This radar system produced unrivaled 3-D images of the Earth's Surface. The mission was launched at 12:31 on February 11, 2000 onboard the space shuttle Endeavour. and led by Commander Kevin Kregel. The crew was Pilot Dominic L. Pudwill Gorie and Mission Specialists Janet L. Kavandi, Janice E. Voss, Mamoru Mohri from the National Space Development Agency (Japanese Space Agency), and Gerhard P. J. Thiele from DARA (German Space Agency). This tape shows the astronauts boarding jet planes at the Shuttle Landing Facility after the Terminal Countdown Demonstration Test.

CASI

Astronauts; Spacecrews; Jet Aircraft; Preflight Operations

20000025467 NASA Kennedy Space Center, Cocoa Beach, FL USA
STS-99 Commander and Pilot for the SRTM Mission, Practice Flight in the Shuttle Training Aircraft
Feb. 09, 2000; In English; Videotape: 5 min. playing time, in color, with sound
Report No.(s): KSC00-00037; NONP-NASA-VT-2000027978; No Copyright; Avail: CASI; B01, Videotape-Beta; V01, Videotape-VHS

The primary objective of the STS-99 mission was to complete high resolution mapping of large sections of the Earth's surface using the Shuttle Radar Topography Mission (SRTM), a specially modified radar system. This radar system produced unrivaled 3-D images of the Earth's Surface. The mission was launched at 12:31 on February 11, 2000 onboard the space shuttle Endeavour, and led by Commander Kevin Kregel. The crew was Pilot Dominic L. Pudwill Gorie and Mission Specialists Janet L. Kavandi, Janice E. Voss, Mamoru Mohri from the National Space Development Agency (Japanese Space Agency), and Gerhard P. J. Thiele from DARA (German Space Agency). This tape shows Commander Kregel and Pilot Gorie getting on board the Shuttle Training Aircraft and practicing approaches for the shuttle landing.
CASI
Spacecrews; Training Aircraft; Crew Procedures (Preflight); Horizontal Spacecraft Landing

20000021243 NASA Goddard Space Flight Center, Greenbelt, MD USA
Flight Dynamics Analysis Branch End of Fiscal Year 1999 Report
Stengle, T., NASA Goddard Space Flight Center, USA; Flores–Amaya, F., NASA Goddard Space Flight Center, USA; January 2000; 46p; In English
Report No.(s): NASA/TM-2000-209485; NAS 1.15:209485; Rept-2000-00275-0; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This report summarizes the major activities and accomplishments carried out by the Flight Dynamics Analysis Branch (FDAB), Code 572, in support of flight projects and technology development initiatives in Fiscal Year (FY) 1999. The report is intended to serve as a summary of the type of support carried out by the FDAB, as well as a concise reference of key analysis results and mission experience derived from the various mission support roles. The primary focus of the FDAB is to provide expertise in the discipline of flight dynamics, which involves spacecraft trajectory (orbit) and attitude analysis, as well as orbit and attitude determination and control. The FDAB currently provides support for missions involving NASA, government, university, and commercial space missions, at various stages in the mission life cycle.
Author
Aerodynamics; Spacecraft Trajectories; Trajectory Analysis; Attitude (Inclination); Goddard Trajectory Determination System; Orbit Calculation; Trajectory Planning

11
CHEMISTRY AND MATERIALS (GENERAL)

Includes general research topics related to the composition, properties, structure, and use of chemical compounds and materials as they relate to aircraft, launch vehicles, and spacecraft.

20000025399 National Space Development Agency, Office of Research and Development, Tsukuba, Japan
Catalytic Effects of Heat Shield Materials in Dissociated Air
Mizuno, Masahito, National Space Development Agency, Japan; Morino, Yoshiki, National Space Development Agency, Japan; Watanabe, Yasuo, National Aerospace Lab., Japan; Ninth Thermal and Fluids Analysis Workshop Proceedings; November 1999, pp. 181-204; In English; See also 20000025387; No Copyright; Avail: CASI; A03, Hardcopy; A03, Microfiche

Catalysis of the heat shield materials was preliminarily evaluated by use of arc heated wind tunnel test data and approximate solution on heating rates. Test specimens are C/C materials with Chemical Vapor Deposition(CVD)-SiC coating. Evaluation of the material catalysis was conducted using aerodynamic heating test data obtained by both a 750 kW arc heated wind tunnel of the National Space Development Agency of Japan (NASDA) and a 1 MW arc wind tunnel of the Institut fur Raumfahrtsysteme of the Universitat Stuttgart (IRS). Aerodynamic heating rates on the surface of the specimen were calculated based on the surface temperature distribution. On the other hand, fully catalytic heating rate was calculated by use of the data of heat flux measurements. The ratio of these values are compared with the theoretical values (based on Goulard's theory) and recombination rate constant was estimated to be 5-6 m/s. The difference between NASDA test and IRS test is also discussed in order to verify

the proposed estimation process. Dissociated flow diagnostic in arc wind tunnels would be the most important research issue in the next step.
Author
Heat Shielding; Catalysis; Wind Tunnel Tests; Aerodynamic Heating; Refractory Materials

20000020833 General Electric Co., Combustion Center of Excellence, Cincinnati, OH USA
Empirical and Anchored Methodologies for Controlling Combustion Dynamics
Pandalai, Raghavan P., General Electric Co., USA; Hsiao, George C., General Electric Co., USA; Mongia, Hukam C., General Electric Co., USA; Gas Turbine Engine Combustion, Emissions and Alternative Fuels; June 1999, pp. 5-1 - 5-14; In English; See also 20000020829; Copyright Waived; Avail: CASI; A03, Hardcopy; A06, Microfiche

This paper describes the empirical and anchored methodologies developed at General Electric Aircraft Engines (GEAE) to control combustion dynamics in aircraft and aero-derivative industrial turbine engine combustion systems. Combustion instability problems in aircraft and more recently in aero-derivative industrial engine combustors have been a serious problem during development, and in some production engines. The conventional approach to this problem has been based largely on empirical correlations and design experience. The advent of low emissions combustors for aircraft and industrial applications which incorporate several innovative technologies have put additional pressures to look at this problem from a more fundamental viewpoint so as to identify a dynamics 'fix' quickly based on root cause, and minimum testing to demonstrate the fix. To achieve this goal, a physics based combustion dynamics model is developed and described in this paper. The acoustic abatement technology that has made an optimum use of both the passive and active control technique (hybrid control system) employed in GEAE's product lines consistent with customers' needs has also been integrated into this model. The formulation of the dynamics model is based on the exact solution of the acoustic wave equation and is capable of incorporating several features unique to gas turbine combustors. The current approach is built on an acoustic based framework and the total combustion system from compressor exit to first stage turbine nozzle including fuel delivery system, fuel premixer and acoustic damping devices are incorporated into this model because of their impacts on overall dynamics. Engine test data obtained during the development phase of GEAE's ultra low emission industrial engine combustor development program was used to demonstrate the feasibility of the model and the anchored approach. The predicted trends not only agreed very well with test data, but also demonstrated the capability of the model to distinguish between acoustically active and inactive regimes of operation.
Author
Gas Turbine Engines; Combustion Stability; Aircraft Engines; Combustion Physics; Engine Design; Mathematical Models

20000020834 Motoren- und Turbinen-Union G.m.b.H., Munich, Germany
NO(x) Reduction by Lean Premixed Prevaporized Combustion
Ripplinger, T., Motoren- und Turbinen-Union G.m.b.H., Germany; Zarzalis, N., Motoren- und Turbinen-Union G.m.b.H., Germany; Meikis, G., Motoren- und Turbinen-Union G.m.b.H., Germany; Hassa, C., Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Germany; Brandt, M., Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Germany; Gas Turbine Engine Combustion, Emissions and Alternative Fuels; June 1999, pp. 7-1 - 7-12; In English; See also 20000020829
Contract(s)/Grant(s): BMBF-0326782D/215; Copyright Waived; Avail: CASI; A03, Hardcopy; A06, Microfiche

A low emission working by lean combustion with premixing and prevaporizing of liquid fuel is presented for aero jet engine and power generation applications. A model rectangular combustor was designed and manufactured as a portion from a full annular combustor and investigated in medium- and high-pressure tests at burner inlet temperatures up to 820 K and at operating pressures up to 20 bar. The design of the combustor was supported by 3D CFD calculations, which were conducted in order to optimise the flow field within the combustor, especially with a view to creating a sufficient recirculation zone for flame stabilization. In addition to the combustor tests, investigations were carried out with the two phase flow within the premixer by means of optical measuring techniques at the German Aerospace Research Establishment (DLR Cologne). With the present design of the premixing duct and the airblast atomizer the liquid fuel can almost be completely evaporated within a premixing length of 150 mm, corresponding to a residence time of the fuel/air mixture in the premixer of 1.25 - 1.5 ms. The model combustor was operated at burner inlet temperatures of up to 820 K and at operating pressures of up to 20 bar with no autoignition of the fuel/air mixture within the premixing duct or flash back of the flame into the premixer occurring. The combustor combines very low NO(x) emissions (up to 85 % less NO(x) than a low NO(x) diffusion combustor) with high combustion efficiencies (above 99 % and a sufficient stability range (Phi(min.,Primary) = 0.5). Therefore, the present LPP concept provides a promising configuration for an ultra low NO(x) combustor, both for aero engine and power generation applications.
Author
Nitrogen Oxides; Aircraft Engines; Combustion; Combustion Products; Emission; Prevaporization; Premixing; Two Phase Flow

20000020835 South Carolina Energy Research and Development Center, Advanced Gas Turbine Systems Research, Clemson, SC USA

Status of Catalytic Combustion R and D for the Department of Energy Advanced Turbine Systems Program

Fant, D., South Carolina Energy Research and Development Center, USA; Jackson, G., Maryland Univ., USA; Karim, H., Precision Combustion, Inc., USA; Newburry, D., Siemens Westinghouse Power Corp., USA; Dutta, P., Solar Turbines, USA; Smith, K., Solar Turbines, USA; Smith, D., Rolls-Royce Allison, USA; Dibble, R., California Univ., USA; Gas Turbine Engine Combustion, Emissions and Alternative Fuels; June 1999, pp. 8-1 - 8-15; In English; See also 20000020829; Copyright Waived; Avail: CASI; A03, Hardcopy; A06, Microfiche

This paper discusses paper discusses some of the advanced concepts and fundamental R&D needs associated with implementing catalytic combustion systems to achieve ultra-low NO(x) emissions in the next generation of land-based gas turbine engines. In particular, the paper presents the development status and current design challenges being addressed by Siemens Westinghouse Power Corporation, Solar Turbines, and Rolls-Royce Allison, as part of the U.S. Department of Energy's (DOE) Advanced Turbine Systems (ATS) program. In addition, issues on catalytic combustion economics, durability and operability will be highlighted.

Author

Gas Turbine Engines; Catalysis; Combustion; Nitrogen Oxides; Emission

20000020851 California Univ., Combustion Lab., Irvine, CA USA

Advance Fuel Injection Strategies for High Performance Gas Turbine Engines

Samuelsen, Scott, California Univ., USA; McDonell, Vince, California Univ., USA; Gas Turbine Engine Combustion, Emissions and Alternative Fuels; June 1999, pp. 24-1 - 24-14; In English; See also 20000020829; Original contains color illustrations; Copyright Waived; Avail: CASI; A03, Hardcopy; A06, Microfiche

Advanced gas turbine combustion systems will demand fuel injection strategies that are efficient in the rapid mixing of fuel and air, sophisticated in the ability to control the spatial distribution of the fuel, and both sufficiently flexible and intelligent to accommodate change over the duty cycle of the engine. The paper reports performance of a candidate injector and strategies, through mechanistic studies with advanced diagnostics, to optimize the system.

Author

Fuel Injection; Fuel Combustion; Gas Turbine Engines; Pollution Control; Injectors

20000020857 Rolls-Royce Allison, Indianapolis, IN USA

Fuel/Air Preparation in the Design of Low Emissions Gas Turbine Combustion Systems

Razdan, Mohan K., Rolls-Royce Allison, USA; Gas Turbine Engine Combustion, Emissions and Alternative Fuels; June 1999, pp. 34-1 - 34-11; In English; See also 20000020829; Copyright Waived; Avail: CASI; A03, Hardcopy; A06, Microfiche

This paper discusses issues related to practical fuel injection methods, and the key factors affecting the fuel/air mixing process in low emission gas turbine combustors. The mixing of fuel and air has to be accomplished in the shortest possible residence time both for current retroflt applications as well as for future high performance engines that operate at substantially higher inlet temperatures and pressures, where flashback and autoignition are serious concerns. The choice of a fuel injection method is strongly influenced not only by the selected geometry and size of a fuel/air preparation module but also by its interaction with the module air flow. Combining pressure swirl and prefilming airblast atomization concepts in a single hybrid design presents an attractive approach for achieving satisfactory atomization over a wide operating range of the combustor. Internally mixed atomization concepts show beneficial effects on fuel atomization. A fuel concentration profile tailored to the local velocity profile at the mixing module exit minimizes the flashback propensity. Autoignition concerns will limit the application of fully prevaporized lean premixed low emission approach to operating pressures up to 40 to 50 atmospheres.

Author

Air Flow; Spontaneous Combustion; Ignition; Flashback; Engine Design; Fuel Injection; Combustion Chambers; Gas Turbine Engines

20000020858 Imperial Coll. of Science Technology and Medicine, Thermofluids Section, London, UK

Experiments in a Small Gas-Turbine Combustor with Gas and Liquid Fuels

Heyes, A. L., Imperial Coll. of Science Technology and Medicine, UK; Jelercic, D., Imperial Coll. of Science Technology and Medicine, UK; Whitelaw, J. H., Imperial Coll. of Science Technology and Medicine, UK; Gas Turbine Engine Combustion, Emissions and Alternative Fuels; June 1999, pp. 35-1 - 35-17; In English; See also 20000020829; Original contains color illustrations

Contract(s)/Grant(s): EPSRC-GR/K-60985; Copyright Waived; Avail: CASI; A03, Hardcopy; A06, Microfiche

Measurements of velocity, temperature, emissions and droplet diameters are reported for combustion of kerosene in a sector of a gas-turbine combustor at atmospheric pressure and air-fuel ratios and preheat temperatures corresponding to cruise and take-off conditions. The results allow comparison of flows with fuelling devices which include gas jets, a T-vaporiser and two arrangements of fan sprays, and show the extent to which droplet diameters and velocities were affected by the rate of fuel flow and by the air preheat in the main vortex of the primary zone. A single fan spray led to a central core of combustion with cold flow on either side so that the pattern factor had no practical value and subsequent experiments made use of two sprays. The droplet numbers density fell rapidly with distance from the injectors and with increasing air-fuel ratio and preheat temperature, and the arithmetic and Sauter mean diameters tended to decrease as droplets evaporated and burned. The exit-plane profiles of temperature were more uniform with the higher preheat temperature and lower air-fuel ratio which resulted in a combustion efficiency of 98.3% The lower preheat temperature led to a three-fold increase in concentrations of unburned hydrocarbon and efficiency of 91.6%. Emissions were similar with the fan spray and the vaporiser arrangements, with NOx concentrations larger by 10% in the rich flows and smaller by 25% with the higher air-fuel ratio and lower preheat temperature.
Author
Combustion Chambers; Gas Turbine Engines; Engine Design; Propulsion System Performance; Fuel Combustion; Fuel Flow

20000020864 Pennsylvania State Univ., University Park, PA USA
Optimization of Active Control Systems for Suppressing Combustion Instability
Lee, Jong Guen, Pennsylvania State Univ., USA; Hong, Boe–Shong, Pennsylvania State Univ., USA; Kim, Kwanwoo, Pennsylvania State Univ., USA; Yang, Vigor, Pennsylvania State Univ., USA; Santavicca, Domenic, Pennsylvania State Univ., USA; Gas Turbine Engine Combustion, Emissions and Alternative Fuels; June 1999, pp. 41-1 - 41-12; In English; See also 20000020829
Contract(s)/Grant(s): N00014-96-1-0405; Copyright Waived; Avail: CASI; A03, Hardcopy; A06, Microfiche

Combustion instabilities have proven to be a major factor limiting the development of high performance, low emissions gas turbine engines. This is a result of the fact that our current understanding of the underlying phenomenology of unstable combustion is incomplete, making it difficult to design high performance, low emissions combustors which are stable over their entire operating range. This problem is further aggravated by the fact that achieving stable combustion in a single-nozzle test of the actual combustor hardware is not a guarantee that the full-scale engine will not exhibit instabilities. Active combustion control provides an alternate approach to the successful development of high performance, low emissions gas turbine combustion systems. In theory, an active control system can be designed without a priori understanding of the nature or phenomenology of the instability. In practice, however, the optimization of a successful active control system requires a fundamental understanding of the phenomenology of unstable combustion. particularly in the specific engine of interest and over the complete range of desired engine operating conditions. This paper presents results from a research program aimed at the development and optimization of an active control system for use in a low emissions gas turbine combustor. An overview of the control methodology is presented first. Then the theoretical model, which forms the basis of the model-based controller, is presented and preliminary results discussed. and lastly, experimental measurements of the stability characteristics of the lean premixed, dump combustor used in this study and of the response of the secondary fuel injector and the combustor to various control parameters are presented and the use of this type of information to optimize the control system is discussed.
Author
Active Control; Combustion; Combustion Stability; Combustion Chambers; Gas Turbine Engines; Premixing

20000020866 Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Inst. for Propulsion Technology, Cologne, Germany
Optical Measurements of Spray Combustion in a Single Sector Combustor from a Practical Fuel Injector at Higher Pressures
Behrendt, T., Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Germany; Frodermann, M., Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Germany; Hassa, C., Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Germany; Heinze, C., Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Germany; Lehmann, B., Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Germany; Stursberg, K., Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Germany; Gas Turbine Engine Combustion, Emissions and Alternative Fuels; June 1999, pp. 43-1 - 43-13; In English; See also 20000020829; Copyright Waived; Avail: CASI; A03, Hardcopy; A06, Microfiche

A research combustor for the investigation of spray combustion of practical aeroengine fuel injectors has been built. It approximates a single sector of an annular combustor. It allows optical access for laser based measuring techniques with point and planar measuring volumes and can be operated up to 20 bar with preheat temperatures of up to 850 K. For this contribution, the combustor has been operated at 3, 6 and 9 bar and at preheat temperatures of 473 K and 673 K with a technology injector supplied by BMW-RR. The isothermal flowfield was investigated by Laser Doppler Anemometry and the combusting flow by

Phase Doppler Anemometry, Laser Induced Fluorescence of Kerosene and OH and imaging of the spontaneous OH emission. The injector showed a large central recirculation with an almost radial expansion of the gas flow without outer recirculation. At 6 bar, 473 K preheat and AFR 20, the bulk of the spray is evaporated before the reaction rate as signalled by OH* emission intensity reaches high values, which confirms earlier estimates postulating external group combustion for aeroengines. The investigated atomizer shows a marked influence of temperature and almost no influence of pressure on the measured drop sizes which was attributed to the design of the internal airflow promoting prompt atomization as the dominant atomization mode.
Author
Optical Measurement; Pressure Effects; Combustion; Combustion Chambers; Combustible Flow; Fuel Injection; Air Flow; Aircraft Engines; Injectors

20000024794 Naval Facilities Engineering Service Center, Port Hueneme, CA USA
Floor Coating Specification for Interior Aircraft Maintenance Shops *Final Report, May - Oct. 1999*
Gaughen, C. D.; Nov. 1999; 26p; In English
Report No.(s): AD-A372495; SP-2059-SHR; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
The Special Publication was developed for use with the Naval Facilities Engineering Service Center's (NFESC) Users Guide titled "Concrete Floor Condition Assessment (UG-2038-SHR)." A condition assessment in accordance to the Users Guide is required prior to specifying the coating system enclosed in Appendix A. Appendix A contains a four- coat, thick film (1/4"), non-conductive, chemically resistant interior coating system designed to protect the following aircraft maintenance shop floors: 1) Engine maintenance, 2) Airframes, 3) Avionics, and 4) Aviation armament. Presented within the publication are the following sections: A) Condition assessment requirements, B) Coating system, C) Photographs showing the sequential installation, D) Quality control, and E) Cleaning coating system.
DTIC
Coating; Aircraft Maintenance; Floors; Protective Coatings; Quality Control

20000025253 Naval Facilities Engineering Service Center, Port Hueneme, CA USA
Hangar Floor Coating Specifications: Thin Film, Thick Film, and Overcoating Sound Coating Systems *Final Report, May-Sep 1999*
Gaughen, C. D.; Oct. 1999; 56p; In English
Report No.(s): AD-A372511; NFESC-SP-2057-SHR; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche
The Special Publication was developed for use with the Naval Facilities Engineering Service Center's (NFESC) Users Guide titled "Condition Assessment and Coating Recommendations for Aircraft Maintenance Hangars (UG-2036-SHR)." A condition assessment in accordance to the Users Guide is required prior to specifying one of three hangar floor coating systems: (1) Thin film coating system (16 mils: 1 mil = 0.001"), (2) Thick film coating system (250 mils), and (3) Overcoating sound coating systems. Coating specifications based upon the above coating systems are enclosed in the Appendices. Presented within the publication are the following sections: (A) Coating system requirements, (B) Quality control, (C) Chemical resistance of topcoat, (D) Cleaning coating systems, and (E) Conductive coating system.
DTIC
Hangars; Floors; Coating

20000025447 Naval Facilities Engineering Service Center, Port Hueneme, CA USA
Condition Assessment and Coating Recommendations for Aircraft Maintenance Hangars *Final Report, May - Sep. 1999*
Gaughen, C. D.; Oct. 1999; 16p; In English
Report No.(s): AD-A372490; NFESC-UG-2036-SHR; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
The Users Guide presents a systematic approach to assessing the condition of aircraft maintenance hangar floors prior to specifying one of three coating systems: (1) Thin film coating system (16 mils: 1 mil = 0.001"), (2) Thick film coating system (250 mils), and (3) Overcoating sound coating systems. Coating specifications based upon the above coating systems are presented in the Naval Facilities Engineering Service Center's (NFESC) Special Publication titled Hangar Floor Coating Specifications: Thin Film, Thick Film, and Overcoating Sound Coating Systems (SP-2057-SHR). by assessing the condition of hangar floor surfaces, coating failures resulting from the following practices should decrease: (1) Overcoating unsound coating systems, (2) Coating concrete with low surface strength, (3) Coating concrete with high levels of hydrocarbon contamination (oils, fuels, skydrol), and (4) Coating concrete with a high rate of moisture vapor emission.
DTIC
Aircraft Maintenance; Hangars; Protective Coatings

20000020843 Karlsruhe Univ., Lehrstuhl und Inst. fuer Thermische Stroemungsmaschinen, Germany
Validation and Application of a Droplet Evaporation Model for Real Aviation Fuel
Prommersberger, K., Karlsruhe Univ., Germany; Maier, G., Karlsruhe Univ., Germany; Wittig, S., Karlsruhe Univ., Germany; Gas Turbine Engine Combustion, Emissions and Alternative Fuels; June 1999, pp. 16-1 - 16-13; In English; See also 20000020829
Contract(s)/Grant(s): DFG-SFB-167; Copyright Waived; Avail: CASI; A03, Hardcopy; A06, Microfiche

Fuel droplet dispersion and evaporation within the premix duct of a Lean Premixed Prevaporized (LPP) combustor is investigated both experimentally and numerically with a two phase flow code. Mean droplet velocity and diameter distribution have been measured in different axial planes with a Phase Doppler Particle Analyzer. The data of the droplet and gas flow measurements near the nozzle is used to establish the boundary conditions for the simulation. The two phase flow is calculated using a Lagrangian type particle tracking method. For the first time an evaporating fuel spray is simulated by the Distillation Curve evaporation model. Based on fuel property data, this model allows the consideration of the multicomponent behavior of aviation fuels. Downstream measurements of droplet size, volume flux and velocity are compared with the numerical results. The objective of the study is to present the simulation of a fuel spray evaporation process inside a LPP duct with reasonable computational effort. The numerical calculation of spray propagation and evaporation demonstrates, that the Distillation Curve evaporation model is able to cover typical multicomponent behavior of aviation fuels under realistic operating conditions. The comparison with the experimental data shows that for the given high relative velocities between gas phase and droplets secondary droplet breakup has to be taken into account.
Author
Aircraft Fuels; Fuel Sprays; Drop Size; Two Phase Flow; Evaporation; Computerized Simulation; Mathematical Models; Gas Flow; Atomizing

20000020870 Pisa Univ., Dipt. di Energetica, Italy
Modification of the Fuel Control System of a Gas Turbine Engine from Kerosene to Hydrogen
Dini, Dino, Pisa Univ., Italy; Gas Turbine Engine Combustion, Emissions and Alternative Fuels; June 1999, pp. 48-1 - 48-9; In English; See also 20000020829; Copyright Waived; Avail: CASI; A02, Hardcopy; A06, Microfiche

Fuels for engines of road vehicles, as well of boats or aircraft, based on oil derivatives, are well known as essential factors for the air pollution. In order to adapt a gas turbine engine for the lowest emission operation, its fuel control system has to be modified from the use of a hydromechanical kerosene controller (not able to control gaseous hydrogen) into a digital system for gaseous hydrogen, consisting of an electronic control box which will modulate an electrical/pneumatical valve as a function of engine speed. This is described in the paper, as it has been tested in our laboratory, especially regarding experimental arrangements and measurements. Problems with the ignition of the oxyhydrogen gas have been solved, and the gain factors for the digital control laws were calculated using measured performance data of the kerosene driven engine. Finally, a safe 202 kW gas turbine engine is now running with gaseous hydrogen. Details of the combustion tests of the gaseous hydrogen at the operating performance are given. The data were taken upon pressure losses of the fuel nozzles, ignition performance, temperature distributions at the combustor outlet, combustion efficiency, liner wall temperature distributions, NOx emission level, noise level, operating performance, etc.
Author
Controllers; Electronic Control; Fuel Control; Gas Turbine Engines; Combustion; Hydrogen Fuels; Exhaust Emission; Digital Systems; Environment Effects

12
ENGINEERING (GENERAL)

Includes general research topics to engineering and applied physics, and particular areas of vacuum technology, industrial engineering, cryogenics, and fire prevention.

20000020689 NASA Glenn Research Center, Cleveland, OH USA
1998 NASA Seal/Secondary Air System Workshop, Volume 1
Steinetz, Bruce, NASA Glenn Research Center, USA; Hendricks, Robert, NASA Glenn Research Center, USA; July 1999; 442p; In English; Seal/Secondary Air System, 22-23 Oct. 1998, Cleveland, OH, USA
Contract(s)/Grant(s): RTOP 523-21-13
Report No.(s): NASA/CP-1999-208916/VOL1; E-11666/VOL1; NAS 1.55:208916/VOL1; No Copyright; Avail: CASI; A19, Hardcopy; A04, Microfiche

The 1998 NASA Seal/Secondary Air System Workshop was divided into three major areas with limited materials presented in Volume II: (1) overviews of the (NASAs high speed research (HSR) and DOE's advanced turbine engine systems (ATS)) gas turbine programs and the general aviation program (GAP) with emphasis on sealing methods and results; (2) sealing concepts and methods and results including experimental facilities and numerical predictions; and (3) reviews of the numerical engine simulation and aerospace vehicles and concepts (Trailblazer, Bantam, and X-38).
Author
Numerical Analysis; General Overviews; Gas Turbine Engines; Aerospace Vehicles; NASA Programs; Seals (Stoppers)

20000020829 Research and Technology Organization, Applied Vehicle Technology Panel, Neuilly-sur-Seine, France
Gas Turbine Engine Combustion, Emissions and Alternative Fuels *La Combustion dans les Turbomoteurs, les Emissions et les Carburants de Remplacement*
June 1999; 608p; In English; In French, 12-16 Oct. 1998, Lisbon, Portugal; See also 20000020830 through 20000020875; Original contains color illustrations
Report No.(s): RTO-MP-14; AC/323(AVT)TP/10; ISBN 92-837-0009-0; Copyright Waived; Avail: CASI; A99, Hardcopy; A06, Microfiche

The symposium dealt with Gas Turbine Engine Combustion, Emissions, and Alternative Fuels. Forty-six papers and a Keynote Address elucidated the role of the combustion process as a crucial factor of engine performance and operability under various conditions including non-standard, new fuels, and environmental effects of civil and military interest. There were 12 Sessions covering the following topics (some in 2 sessions): Gas Turbines in Land, Sea and Air Applications, Low-Emission Combustors, Combustion Modelling, Optical Measurements, Emissions, Combustor Design, Ignition Processes, Active Combustion Control, and Alternative Fuels
Author
Gas Turbine Engines; Conferences; Combustion; Fuels; Exhaust Emission

20000023222 Arizona State Univ., Coll. of Engineering and Applied Sciences, Tempe, AZ USA
Advanced Electromagnetic Methods for Aerospace Vehicles *Final Report, 1 Jan. 1990 - 31 Dec. 1999*
Balanis, Constantine A., Arizona State Univ., USA; Polycarpou, Anastasis, Arizona State Univ., USA; Birtcher, Craig R., Arizona State Univ., USA; Georgakopoulos, Stavros, Arizona State Univ., USA; Han, Dong–Ho, Arizona State Univ., USA; Ballas, Gerasimos, Arizona State Univ., USA; [1999]; 133p; In English
Contract(s)/Grant(s): NAG1-1082
Report No.(s): TRC-EM-CAB-0001; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

The imminent destructive threats of Lightning on helicopters and other airborne systems has always been a topic of great interest to this research grant. Previously, the lightning induced currents on the surface of the fuselage and its interior were predicted using the finite-difference time-domain (FDTD) method as well as the NEC code. The limitations of both methods, as applied to lightning, were identified and extensively discussed in the last meeting. After a thorough investigation of the capabilities of the FDTD, it was decided to incorporate into the numerical method a subcell model to accurately represent current diffusion through conducting materials of high conductivity and finite thickness. Because of the complexity of the model, its validity will be first tested for a one-dimensional FDTD problem. Although results are not available yet, the theory and formulation of the subcell model are presented and discussed here to a certain degree. Besides lightning induced currents in the interior of an aircraft, penetration of electromagnetic fields through apertures (e.g., windows and cracks) could also be devastating for the navigation equipment, electronics, and communications systems in general. The main focus of this study is understanding and quantifying field penetration through apertures. The simulation is done using the FDTD method and the predictions are compared with measurements and moment method solutions obtained from the NASA Langley Research Center. Cavity-backed slot (CBS) antennas or slot antennas in general have many applications in aircraft-satellite type of communications. These can be flushmounted on the surface of the fuselage and, therefore, they retain the aerodynamic shape of the aircraft. In the past, input impedance and radiation patterns of CBS antennas were computed using a hybrid FEM/MoM code. The analysis is now extended to coupling between two identical slot antennas mounted on the same structure. The predictions are performed using both the hybrid FEM/MoM and the FDTD NEWS code. The results are compared with each other as well as with measurements performed in the ElectroMagnetic Anechoic Chamber (EMAC) of ASU. In addition to self and mutual impedances versus frequency, the comparisons include mutual coupling S(sub 12) as a function of distance for various slot orientations.
Derived from text
Electromagnetic Fields; Lightning; Aerospace Vehicles; Helicopters; Fuselages; Mathematical Models; Method of Moments; Simulation; Slot Antennas

20000025018 Air Force Research Lab., Rome, NY USA
Simultaneous Adaptive Co-Channel Speaker Separation, ***Jan. 1994 - Jan. 1998***
Benincasa, Daniel S., Air Force Research Lab., USA; Nov. 1999; 210p; In English
Contract(s)/Grant(s): AF Proj. 4594
Report No.(s): AD-A372110; AFRL-IF-RS-TR-1999-162; No Copyright; Avail: CASI; A03, Microfiche; A10, Hardcopy

In this research, we have developed several unique techniques used in the separation of a speech signal corrupted by another talker's speech recorded over a single channel. Historically, this has been referred to as the cocktail party problem. Our work is useful in such applications as separating the speech signals recorded onto an in-flight voice data recording box from the cockpit of an airplane, enhancing the quality of speech transmitted through a hearing aid, and in the enhancement of speech transmitted over a noisy communication channel. We have made significant contributions to the field of speaker separation. We have developed and tested an adaptive co-channel speaker separation system which can simultaneously estimate the speech of two speakers recorded onto a single channel. We have developed and tested several methods to estimate the voicing state of a co-channel speech segment. We have developed and tested a technique to estimate the fundamental frequency and pitch contour of each speaker. This technique is based on the maximum likelihood pitch estimator and harmonic magnitude suppression. Using the estimate of the fundamental frequency, we have developed a technique to estimate the harmonic parameters of overlapping voice speech segments. Finally, we have developed and tested an innovative technique to simultaneously estimate overlapping voiced speech segments using a constrained nonlinear least squared optimization algorithm. These techniques have been integrated into end to end speaker separation system to separate co-channel speech.
DTIC
Cockpits; Voice Communication; Statistical Analysis; Multichannel Communication; Speech Recognition

20000023228 NASA Marshall Space Flight Center, Huntsville, AL USA
Unmanned Vehicle Guidance Using Video Camera/Vehicle Model (MSFC Center Director's Discretionary Fund) ***Final Report***
Sutherland, T., NASA Marshall Space Flight Center, USA; December 1999; 4p; In English
Contract(s)/Grant(s): Proj. 97-23
Report No.(s): NASA/TM-1999-209788; NAS 1.15:209788; M-956; No Copyright; Avail: Issuing Activity; Abstract Only

A video guidance sensor (VGS) system has flown on both STS-87 and STS-95 to validate a single camera/target concept for vehicle navigation. The main part of the image algorithm was the subtraction of two consecutive images using software. For a nominal size image of 256 x 256 pixels this subtraction can take a large portion of the time beta,een successive frames in standard rate video, leaving very little time for other computations. The purpose of this project was to integrate the software subtraction into hardware to speed up the subtraction process and allow for more complex algorithms to be performed, both in hardware and software.
Author
Guidance Sensors; Space Transportation System; Video Communication; Computer Programs; Cameras; Pilotless Aircraft

20000025406 Dynamic Soft Analysis, Inc., Pittsburgh, PA USA
Thermal Management of Aero and Space Electronic Boards
Lazzaro, Greg, Dynamic Soft Analysis, Inc., USA; Andrikowich, Tom, Allied-Signal Aerospace Co., USA; Ninth Thermal and Fluids Analysis Workshop Proceedings; November 1999, pp. 131-137; In English; See also 20000025387; No Copyright; Avail: CASI; A02, Hardcopy; A03, Microfiche

The thermal management of electronic boards for aero and space applications must conform to severe requirements between limited heat removal options and limited weight tolerance. With the trend toward higher packaging, density in chips and faster clock speeds, the power dissipation of each component has increased over the last few decades. Also, the condensed system packaging has led to an increase in power per unit area on electronic boards. Thus, the most severe thermal management challenges occur in aerospace electronics where reliability issues are high and the means for heat removal are limited. As a result of these conditions, thermal analysis software must be an integrated step along with component placement, routing, electronic simulation, mechanical analysis, and reliability prediction. The use of thermal analysis software helps to identify thermal problems during the early stages of design. It also provides various options to resolve possible thermal problems during the design process. This process will reduce expensive corrections to prototypes by predicting the thermal performance before the first prototype is constructed. In routine product design. engineers generally use thermal analysis software along with other CAE software. A

specific example of an aircraft engine control unit from Allied-Signal Aerospace is provided as an example. Modeling specifics and temperature comparisons between the software and test data will be presented.
Author
Thermal Analysis; Temperature Control; Aircraft Engines; Applications Programs (Computers); Aerospace Systems; Systems Integration

20000020812 Rolls-Royce Ltd., Technology Dept., Derby, UK
Part Speed Flutter of Transonic Fans
Chew, J. W., Rolls-Royce Ltd., UK; Hamby, R. J., Rolls-Royce Ltd., UK; Marshall, J. G., Rolls-Royce Ltd., UK; Vahdati, M., Imperial Coll. of Science Technology and Medicine, UK; Design Principles and Methods for Aircraft Gas Turbine Engines; February 1999, pp. 26-1 - 26-10; In English; See also 20000020789; Original contains color illustrations; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

Until recently, only rudimentary methods have been available to assess designs for susceptibility to part speed flutter, but progress is now being made with more advanced CFD-based models. Earlier work has shown that coupled structural-fluid, non-linear methods may usefully be applied to this problem, but have also indicated that more computationally efficient linear methods have a role. One such linear approach is described in this paper and demonstrated on two research fans, representative of civil and military engines. Calculations are consistent with experimental observations in that the civil fan was found susceptible to flutter while the military fan was not. The results confirm the utility of the linear approach and give further insight into the physics of this type of flutter.
Author
Computational Fluid Dynamics; Mathematical Models; Turbofans; Transonic Flutter

20000020852 Sener S.A., Madrid, Spain
Turbulent Structure of Generic LPP Gas Turbine Combustors
Lazaro, B., Sener S.A., Spain; Gonzalez, E., Universidad Politecnica de Madrid, Spain; Alfaro, J., Universidad Carlos 3 de Madrid, Spain; Rodriguez, P., Universidad Carlos 3 de Madrid, Spain; Lecuona, A., Universidad Carlos 3 de Madrid, Spain; Gas Turbine Engine Combustion, Emissions and Alternative Fuels; June 1999, pp. 25-1 - 25-12; In English; See also 20000020829; Original contains color illustrations
Contract(s)/Grant(s): CEC-BRPR-CT95-0122; CICYT-C95013002; Copyright Waived; Avail: CASI; A03, Hardcopy; A06, Microfiche

An experimental investigation has been carried out aimed at increasing the knowledge of the turbulent flow features that characterize lean premixed prevaporized combustors for aircraft gas turbine applications. Taking into account constrains imposed by the available facilities, the design of the experimental rigs was performed to reproduce the combustor geometry and conditions being investigated under the EU sponsored LOWNOX-III program. Two different facilities were built, allowing both isothermal and reacting flow characterizations. Flow visualization, and two-component LDA and PIV systems were used as experimental techniques. Initial characterizations are presented and discussed in relation to technological relevant aspects such as combustor stability, efficiency and pollutant generation behavior.
Author
Combustion Chambers; Gas Turbine Engines; Premixing; Pollution Control; Exhaust Gases; Combustion Products; Turbulent Flow; Turbulent Combustion

20000020856 Sheffield Univ., Dept. of Chemical and Process Engineering, UK
The Use of Fluidics in Gas Turbine Combustion Design
Woolhouse, R. J., Sheffield Univ., UK; Tippetts, J. R., Sheffield Univ., UK; Whiteman, M., Sheffield Univ., UK; Young, K. J., Sheffield Univ., UK; Beck, S. B. M., Sheffield Univ., UK; Swithenbank, J., Sheffield Univ., UK; Gas Turbine Engine Combustion, Emissions and Alternative Fuels; June 1999, pp. 33-1 - 33-10; In English; See also 20000020829; Copyright Waived; Avail: CASI; A02, Hardcopy; A06, Microfiche

Current legislation demands clean combustion in gas turbines. One line of work concerning this objective at the University of Sheffield uses no-moving-part fluidic techniques to modulate flow in the combustor. Schemes described include BLC swirl vanes, a multi-inlet "modulated swirl combustor", a switched vortex valve to provide "fluidic VAD" and multiple ejector systems to recover mixing energy from the fuel supply. A brief description is given of a recently-started project which uses a so-called

"turn-up vortex valve" as a fuel injection device to modulate the through flow and the flowfield thereby achieving a form of variable air distribution.
Author
Air Flow; Combustion; Gas Turbine Engines; Engine Design; Vortices; Combustion Chambers

20000024846 Texas A&M Univ., Aerospace Engineering Dept., College Station, TX USA
A Robust Locally Preconditioned Semi-Coarsening Multigrid Algorithm for the 2-D Navier-Stokes Equations
Cain, Michael D., Texas A&M Univ., USA; August 1999; 4p; In English
Contract(s)/Grant(s): NGT2-52226
Report No.(s): Rept-32525-52470-801; No Copyright; Avail: Issuing Activity; Abstract Only

The goal of this thesis is to develop an efficient and robust locally preconditioned semi-coarsening multigrid algorithm for the two-dimensional Navier-Stokes equations. This thesis examines the performance of the multigrid algorithm with local preconditioning for an upwind-discretization of the Navier-Stokes equations. A block Jacobi iterative scheme is used because of its high frequency error mode damping ability. At low Mach numbers, the performance of a flux preconditioner is investigated. The flux preconditioner utilizes a new limiting technique based on local information that was developed by Siu. Full-coarsening and-semi-coarsening are examined as well as the multigrid V-cycle and full multigrid. The numerical tests were performed on a NACA 0012 airfoil at a range of Mach numbers. The tests show that semi-coarsening with flux preconditioning is the most efficient and robust combination of coarsening strategy, and iterative scheme - especially at low Mach numbers.
Author
Airfoils; Navier-Stokes Equation; Multigrid Methods; Computational Fluid Dynamics; Upwind Schemes (Mathematics)

20000025218 Massachusetts Inst. of Tech., Dept. of Aeronautics and Astronautics, Cambridge, MA USA
Active Control of Aeroelasticity and Internal Flows in Turbomachinery *Final Report, 1 Jan. 1996-30 Sep. 1999*
Paduano, J. D.; Epstein, A. H.; Greitzer, E. M.; Cesnik, C. E.; Nov. 1999; 108p; In English
Contract(s)/Grant(s): F49620-96-1-0407
Report No.(s): AD-A372234; AFRL-SR-BL-TR-2000-0003; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

This report describes work carried out at the Gas Turbine Laboratory at MIT during the period 1/1/96 - 9/30/99, in the area of active control of turbomachinery. Within the overall project, three main research areas were pursued. These are, in brief: (1) Active control of rotating stall with inlet distortion; (2) Injectors as actuators for rotating stall control; and (3) Active stabilization of surge in an aeroengine; and (4) Development of an active rotor for aeroelasticity diagnostics, system identification, and control.
DTIC
Active Control; Aeroelasticity; Internal Flow; Turbomachinery

20000025349 Massachusetts Inst. of Tech., Dept. of Ocean Engineering, Cambridge, MA USA
Prediction of Propulsor-Induced Maneuvering Forces Using a Coupled Viscous/Potential-Flow Method for Integrated Propulsors
Warren, Christopher L.; Jun. 1999; 144p; In English
Report No.(s): AD-A372160; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

This thesis develops a method to analyze the maneuvering forces on surfaced and underwater vehicles with complex propulsors. The analysis method is developed for general propellers yet has unique applicability to model highly contracting stern flows associated with integrated propulsors. Integrated propulsors exhibit strong coupling of the various blade rows and duct, if present, to the vehicle stern. The method developed herein provides a robust means to analyze propulsor induced maneuvering forces including those arising from wake adapted, multi-stage, ducted propulsors. The heart of the maneuvering force prediction is a three-dimensional, unsteady lifting surface method developed as the first part of this thesis. The new method is designated PUF-14 for Propeller Unsteady Forces. The lifting surface method uses many advanced techniques. One significant advance is the use of a wake adapted lattice to model the flow through the propulsor. In related research, a 2-D Kutta condition has been augmented using Lagrangian interpolation to dramatically reduce the required computational time to model a 2-D gust. The second thrust of this thesis couples the unsteady lifting surface method with a three-dimensional, time-average Reynolds Averaged Navier Stokes flow solver. Rotating a propeller through a spatially varying flow field causes temporally varying forces on the propeller. From the converged coupled solution, the maneuvering and blade rate forces can be estimated. This thesis explores the relationship of time varying and time average forces in the flow solver and potential flow domains. Similarly, it explores the relationship of the effective inflow in the two domains. Finally, this thesis details the synergistic means to correctly couple the

potential flow method to a viscous solver. Verification and validation of the method have been done on a variety of geometries and vehicles. Preliminary results show good correlation with experiment.
DTIC
Flow Distribution; Propellers; Underwater Vehicles; Underwater Propulsion

20000025388 ICEM CFD Engineering, Berkeley, CA USA
Efficient Integration of CFD into Product Design
Akdag, Vedat, ICEM CFD Engineering, USA; Magnuson, Al, ICEM CFD Engineering, USA; Wulf, Armin, ICEM CFD Engineering, USA; Ninth Thermal and Fluids Analysis Workshop Proceedings; November 1999, pp. 27-36; In English; See also 20000025387; No Copyright; Avail: CASI; A02, Hardcopy; A03, Microfiche

In recent years, CFD has taken rapid strides through the development and application of unified. robust and efficient methods, and CFD grid generation codes have shown major improvements mainly due to stronger links to the underlying CAD geometry. However. many grid generation systems have focused on inadequate interfaces (e.g. IGES) for transferring CAD (Computer Aided Design) geometry into the grid generation environment. These interfaces have limited the utilization of advanced CAD features like parametric geometry definition by grid generation systems - as soon as the geometry is translated for grid generation, the associativity between the parametric geometry and the grid is no longer maintained. ICEM (Integrated Computer Aided Engineering and Manufacturing) CFD's direct CAD interfaces maintain the associations between the CAD model and the grid generation process. Using, ICEM CFD unstructured grids can be directly remeshed on the modified geometry. For structured grids, once the initial topology is defined, changes in the CAD model cause the ICEM CFD grid generation system to produce corresponding changes in the computational grid. The capability of ICEM CFD operating in an integrated geometry and grid generation environment is demonstrated.
Author
Computational Fluid Dynamics; Computer Aided Design; Grid Generation (Mathematics); Applications Programs (Computers); Aircraft Design

20000025487 Sverdrup Technology, Inc., Huntsville, AL USA
An Unsteady Long Bearing Squeeze Film Damper Model, Part 2, Statically Eccentric Operation
Schallhorn, P. A., Sverdrup Technology, Inc., USA; Elrod, D. A., Sverdrup Technology, Inc., USA; Goggin, D. G., Sverdrup Technology, Inc., USA; Majumdar, A. K., Sverdrup Technology, Inc., USA; [2000]; 27p; In English; 38th; 38th Aerospace Sciences Meeting, 10-13 Jan. 2000, Reno, NV, USA
Contract(s)/Grant(s): NAS8-40386; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This paper, the second of a two-part series, presents results of an unsteady rotordynamic analysis of a long-bearing squeeze film damper executing orbits about an off center position using a fluid circuit approach. A series of nodes and branches represent the geometry of the flow circuit. The mass and momentum conservation equations are solved to predict the pressure distribution in the squeeze film. The motion of the bearing is simulated by the variation of geometry within the flow path. This effort represents the first modeling approach which allows for an arbitrary orbit size about an arbitrary position.
Author
Momentum Theory; Rotor Dynamics; Squeeze Films; Finite Volume Method; Rotor Aerodynamics; Vibration Damping; Vibration Isolators

20000025499 NASA Langley Research Center, Hampton, VA USA
Control and Augmentation of Passive Porosity through Transpiration Control
Banks, Daniel W., Inventor, NASA Langley Research Center, USA; Wood, Richard M., Inventor, NASA Langley Research Center, USA; Bauer, Steven X. S., Inventor, NASA Langley Research Center, USA; May 11, 1999; In English
Patent Info.: Filed 22 May 1992; NASA-Case-LAR-14682; US-Patent-5,901,929; US-Patent-Appl-SN-887002; No Copyright; Avail: US Patent and Trademark Office, Hardcopy

A device for controlling pressure loading of a member caused by a fluid moving past the member or the member moving through a fluid. The device consists of a porous skin mounted over the solid surface of the member and separated from the solid surface by a plenum. Fluid from an area exerting high pressure on the member may enter the plenum through the porous surface and exit into an area exerting a lower pressure on the member, thus controlling pressure loading of the member. A transpirational control device controls the conditions within the plenum thus controlling the side force and yaw moment on the forebody.
Official Gazette of the U.S. Patent and Trademark Office
Augmentation; Porosity; Transpiration; Aircraft Control; Skin (Structural Member)

20000021230 NASA Ames Research Center, Moffett Field, CA USA

Development of a Mirror Pointing Mechanism for an Atmospheric Gas Measurement Instrument

Graham, Michael, Sverdrup Technology, Inc., USA; Belous, Adel, Sverdrup Technology, Inc., USA; Brown, Jeffrey, NASA Ames Research Center, USA; Podolske, James, NASA Ames Research Center, USA; Feb. 20, 1998; 15p; In English; 32nd; 32nd Aerospace Mechanisms Symposium, 13-15 May 1998, Cocoa Beach, FL, USA

Contract(s)/Grant(s): RTOP 538-08-12-31; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Development of the Open Path Tunable Infrared Monitor of the Atmosphere (OPTIMA) instrument involved designing a pair of motion systems that could maintain a precise alignment and spatial distance between two mirrors installed on the NASA DC-8 research laboratory aircraft. This is the first airborne optical instrument that allows direct measurement of the gases in the freestream airflow on the exterior of the aircraft. One mirror is mounted within a specially constructed open port cavity in the cabin of the aircraft and the second is mounted 6 meters away on top of the inboard port side (number 2) engine pylon. Three co-aligned laser beams are reflected between the two mirrors 64 times in a Herriott pattern. The resulting sample path length of 384 meters is used to perform a spectral absorption analysis of the airflow between the mirrors. to compensate for normal wing movement and engine oscillations both mirrors were designed as continuously driven mechanisms to maintain alignment within allowable limits. The motion systems of the two mirror assemblies provide five degrees of freedom and are designed to maintain a pointing accuracy within seven arc-sec with a response frequency in 6xcess of 10 Hz. The pylon motion system incorporates controlled pitch and yaw movement. The fuselage motion system compensates for pitch variation as well as linear translation for focal length and vertical aiming of the laser beam via a controlled beam guidance mechanism.

Author

Mirror Point; Atmospheric Chemistry; Atmospheric Composition; Gas Analysis; Measuring Instruments; Research Aircraft

20000020700 NASA Glenn Research Center, Cleveland, OH USA

Tribological Tuft Testing Candidate Brush Seal Materials

DellaCorte, Chris, NASA Glenn Research Center, USA; 1998 NASA Seal/Secondary Air System Workshop; July 1999; Volume 1, pp. 219-234; In English; No Copyright; Avail: CASI; A03, Hardcopy; A04, Microfiche

This paper presents a tribological tuft test method of candidate brush seal materials in viewgraph form. The goals of the research are: 1) to develop test method to tribologically brush seal materials; 2) to evaluate materials to identify potential improvements and trends; and 3) Guide seal material development and selection.

CASI

Tribology; Brush Seals; Turbine Engines; High Temperature Tests

20000020701 Mohawk Innovative Technology, Inc., Albany, NY USA

Advanced Bearings/Seals for General Aviation Engines

Walton, James F., II, Mohawk Innovative Technology, Inc., USA; 1998 NASA Seal/Secondary Air System Workshop; July 1999; Volume 1, pp. 235-242; In English; No Copyright; Avail: CASI; A02, Hardcopy; A04, Microfiche

This paper presents advanced bearings/seals for general aviation engines. The objective is to: 1) Develop preliminary bearings/seals for W.I.G.A (Williams International General Aviation) engine; 2) Enhance/Expand existing compliant foil, and analysis tools for seals; 3) Select materials and coatings (commercialization of NASA PS 304 coatings); and 4) Validate analysis through experiments. This paper is presented in viewgraph form.

CASI

General Aviation Aircraft; Seals (Stoppers); Foil Bearings; Mathematical Models; Gas Turbine Engines

20000020705 Siemens Westinghouse Power Corp., Orlando, FL USA

Advanced Seal Development for Siemens Westinghouse Combustion Turbines

Chupp, Raymond E., Siemens Westinghouse Power Corp., USA; 1998 NASA Seal/Secondary Air System Workshop; July 1999; Volume 1, pp. 285-307; In English; No Copyright; Avail: CASI; A03, Hardcopy; A04, Microfiche

Several efforts are in progress at Siemens Westinghouse to develop advanced sealing for large utility industrial gas turbine engines (combustion turbines). Much of this effort focuses on transitioning aero gas turbine technology to combustion turbines. Brush seals, film riding face and circumferential seals, and other dynamic and static sealing devices are replacing labyrinth and other seals. For combustion gas turbines, advanced sealing can significantly reduce leakage flows because of the enormous size of the components and the relatively constant operating conditions. Challenges include: extremely long operating lives; infrequent but large position excursions; difficulty in coating or treating larger components; plus maintenance, installation, and durability requirements. The development includes rig testing and engine validation of prototype designs. This effort is part of the Advance

Turbine Systems (ATS) engine development being done under a cooperative agreement between Siemens Westinghouse and the US Department of Energy, Office of Fossil Energy.
Author
Gas Turbine Engines; Sealing; Combustion; Systems Engineering; Design Analysis

20000020831 Rolls-Royce Ltd., Coventry, Industrial and Marine Gas Turbines, West Midlands, UK
Advances in a Gas Turbine System for Ship Propulsion
Parker, M. L., Rolls-Royce Ltd., Coventry, UK; MacLeod, P. K., Rolls-Royce Ltd., Coventry, UK; Coulson, M., Rolls-Royce Ltd., Coventry, UK; Gas Turbine Engine Combustion, Emissions and Alternative Fuels; June 1999, pp. 2-1 - 2-9; In English; See also 20000020829; Copyright Waived; Avail: CASI; A02, Hardcopy; A06, Microfiche

For thirty years, the obvious advantages of gas turbines in marine propulsion systems have been fully exploited by many of the world's navies. Conventional naval gas turbine propulsion systems utilize cruise engines (either a diesel or a gas turbine) to provide low speed fuel economy together with a boost gas turbine to provide the high power for top speeds. Fuel efficiency improvements in marine gas turbines have generally progressed in line with aero engine technology advancement. The potential for substantial fuel savings in the future is available through the adoption of complex cycle engines. An intercooled and recuperated (ICR) gas turbine, known as the RM60, went to sea in HMS Grey Goose (the world's first warship to rely entirely upon gas turbine propulsion) in 1953 and continued in service for over 4 years. The RM60, however was not viable for long term production due to its size and technical complexity. The only advanced cycle marine gas turbine currently in development is the intercooled and recuperated WR-21, the development of which is being funded by the USA Navy, the Royal Navy, and French Navy. The highly efficient WR-21, rate at 25.2 MW (ISO), is derived from the Rolls-Royce aero RB211 and latest Trent family of jet engines components being suitably adapted for marine environment. In addition modifications are necessary to integrate the heat exchangers and hot-end variable geometry in an effective manner. The imminent re-introduction of an advanced cycle marine gas turbine will radically improve fuel consumption by up to 30% when averaged over a typical naval duty cycle. This fuel saving, in conjunction with current condition-based maintenance techniques, engine modularization and the potential for retrofit of an ultra-low emission combustion system should cause a re-examination of the dominance of the diesel in many commercial marine applications. The combustion system requirements for the ICR cycle differ significantly from those of a conventional gas turbine, both in terms of aerodynamic and thermal characteristics of the cycle and also the overall system architecture. This paper summarizes the aerodynamic and mechanical design, rig verification, and development engine experience on the WR-21 combustion system to the present time.
Derived from text
Marine Propulsion; Propulsion System Configurations; Propulsion System Performance; Fuel Consumption; Gas Turbine Engines; Engine Design; Engine Parts

20000020832 Naval Air Systems Command, Patuxent , MD USA
Technical Challenges Associated with the Development of Advanced Combustion Systems
VanErp, Christopher A., Naval Air Systems Command, USA; Richman, Marcus H., Naval Air Systems Command, USA; Gas Turbine Engine Combustion, Emissions and Alternative Fuels; June 1999, pp. 3-1 - 3-5; In English; See also 20000020829; Copyright Waived; Avail: CASI; A01, Hardcopy; A06, Microfiche

The U.S. Navy, as a participant in the USA' Integrated High Performance Turbine Engine Technology (IHPTET) initiative, is dedicated to increasing aircraft engine performance to satisfy the propulsion requirements of future Navy aircraft. This is accomplished by identifying the propulsion requirements, in terms of performance and total cost, for specific Navy aircraft. The required engine technology advances are then broken down into specific engine component technology objectives. Advanced technology is then developed on the component level. Once an appropriate level of readiness is reached, the components are then assemble into an engine for an overall advanced propulsion system demonstration. Technologies from this demonstrator engine are then made available to development engine programs, such as the Joint Strike Fighter (JSF), for further development and eventual transition to production engine programs. The figure of merit used to measure performance is engine thrust/weight ratio. The role of the combustor in this endeavor is to provide the necessary temperature rise to increase core engine output. This drives the combustor to operate at higher fuel/air ratios which in turn drives a larger portion of the combustor volume to operate at or near stoichiometric conditions. Combustor operation at these levels must be achieved with an eye to numerous other parameters such as durability, weight, cost and emissions. The technical challenges presented in attempting to meet these oh objectives simultaneously are the subject of this paper.
Derived from text
Aircraft Engines; Combustion Chambers; Engine Design; Gas Turbine Engines; Propulsion

20000020836 United Technologies Research Center, Aeromechanical, Chemical and Fluid Systems, East Hartford, CT USA
Measurement of Spray/Acoustic Coupling in Gas Turbine Fuel Injectors
Anderson, Torger J., United Technologies Research Center, USA; Kendrick, Donald W., United Technologies Research Center, USA; Cohen, Jeffrey M., United Technologies Research Center, USA; Rosfjord, Thomas J., United Technologies Research Center, USA; Gas Turbine Engine Combustion, Emissions and Alternative Fuels; June 1999, pp. 9-1 - 9-9; In English; See also 20000020829; Copyright Waived; Avail: CASI; A02, Hardcopy; A06, Microfiche

A diagnostic to measure the acoustic coupling of air flow with a fuel injector spray has been developed and tested. The instrument measures the mass of fuel within a plane of the spray using planar laser-induced fluorescence. The signal is monitored continuously to measure mass flow fluctuations during acoustic excitation of the flow. A comparison with the acoustic signal provides a measure of the response of the spray to acoustic excitation for a given nozzle design. This paper describes the approach to acquiring a planar-integrated time-dependent signal for response measurements. Results for several nozzle designs are also presented.
Author
Fuel Injection; Air Flow; Gas Turbine Engines; Nozzle Design; Acoustic Coupling; Fuel Sprays; Laser Induced Fluorescence; Optical Measurement

20000020837 Rolls-Royce Ltd., Derby, UK
Soot and Radiation Modelling in Gas Turbine Combustion Chambers
Brocklehurst, H. T., Rolls-Royce Ltd., UK; Moss, J. B., Cranfield Univ., UK; Hurley, C. D., Defence Evaluation Research Agency, UK; Priddin, C. H., Rolls-Royce Ltd., UK; Gas Turbine Engine Combustion, Emissions and Alternative Fuels; June 1999, pp. 10-1 - 10-13; In English; See also 20000020829; Original contains color illustrations; Copyright Waived; Avail: CASI; A03, Hardcopy; A06, Microfiche

The processes of soot formation and burn-out in liquid-fuelled combustors at practically relevant operating conditions remain poorly understood despite their importance in relation to emissions and, through their influence on radiation, to liner durability and life. The development of simplified theoretical models, necessitated by the underlying physical and chemical complexity, incorporates substantial empiricism and is particularly sensitive to scaling and the calibration of model parameters. This is particularly evident in the application of these models to realistic geometries. Previous post processed soot calculations in gas turbine combustion chambers neglecting the effects of radiation have found that predicted soot levels are an order of magnitude too high in comparison to measurements at 6 bar. The situation is worse for full power conditions, where the increased pressure (over 40 bar) can lead to such large amounts of soot being produced, that more carbon is converted to soot than is available in the fuel. In addition, the soot models are not able to capture the measured level of oxidation between the the primary zone and the combustor exit. This paper describes further developments in the modelling of the sooting processes, where the rate of oxidation is captured more accurately and the effects of radiation are treated more completely. The soot is modelled using a flamelet-based approach employing computations of a kerosene laminar counter-flow flame which incorporates detailed reaction kinetics, and radiation heat loss calculated using the Discrete Transfer Radiation Model. The effects of radiation on both the soot chemistry and the flow pattern (via density changers) are modelled by using a family of flamelets each with a different amount of heat loss. The most appropriate flamelet is selected on the basis of the local computed enthalpy, including heat loss due to radiation. Comparisons are presented between model prediction and sampled measurements from a gas turbine combustor at 6 bar Uncertainties remain in relation to the effective soot aerosol surface area and hence the rate of soot hum-out. Encouraging progress is reported on the coupling between soot production and radiation heat transfer for purposes of wall heat flux production.
Author
Gas Turbine Engines; Mathematical Models; Radiation Effects; Combustion Chambers; Soot; Emission

20000020848 National Aerospace Lab., VH Dept., Amsterdam, Netherlands
Modeling the Effects of Operating Conditions and Alternative Fuels on Gas Turbine Performance and Emissions
Visser, W. P. J., National Aerospace Lab., Netherlands; Kluiters, S. C. A., Technische Univ., Netherlands; Gas Turbine Engine Combustion, Emissions and Alternative Fuels; June 1999, pp. 21-1 - 21-11; In English; See also 20000020829; Copyright Waived; Avail: CASI; A03, Hardcopy; A06, Microfiche

With the increasing attention to gas turbine exhaust gas pollution, a need has emerged to assess effects of a variety of operational variables on the emission levels. An effective approach to address this need is to integrate combustor emission models in gas turbine performance models. NLR's generic gas turbine performance simulation environment (GSP) has therefore been extended with a number features for accurate analysis of these effects on the major exhaust gas emissions NO, CO, UHC and Smoke. First, GSP's gas model has been extended to include a detailed description of gas composition including the particular emission species. Second, a new generic multi-reactor combustor model has been developed for detailed modeling of the

processes in a combustor. The combustor model is set up by defining a number of reactors modeling combustion, mixing. steam/water-injection and their effects on emission formation using semi-empirical models for the reaction kinetics. Fuel properties and composition can be specified in detail, enabling analysis of effects of alternative fuels on gas turbine engine performance and emissions. Preliminary validation results with the multi-reactor combustion model corresponded with measured emission data and with expected operating condition effects on emissions. With the NOx model best accuracy was obtained. The accuracy of particularly the CO, UHC and Smoke formation models may he improved by adapting the multi-reactor model to allow for modeling of effects such as film cooling and other effects not covered by a one-dimensional model. The current generic multi-reactor combustor module will be used for easy implementation of improved emission models in the future. This work will also involve extensive validation using detailed engine. combustor and emission data.
Author
Combustion; Gas Turbine Engines; Combustion Physics; Mathematical Models; Exhaust Emission; Exhaust Gases; Combustion Chambers

20000023166 Virginia Polytechnic Inst. and State Univ., Blacksburg, VA USA
Equivalent Skin Analysis of Wing Structures Using Neural Networks *Final Report*
Liu, Youhua, Virginia Polytechnic Inst. and State Univ., USA; Kapania, Rakesh K., Virginia Polytechnic Inst. and State Univ., USA; [2000]; 35p; In English
Contract(s)/Grant(s): NAG1-1884; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

An efficient method of modeling trapezoidal built-up wing structures is developed by coupling. in an indirect way, an Equivalent Plate Analysis (EPA) with Neural Networks (NN). Being assumed to behave like a Mindlin-plate, the wing is solved using the Ritz method with Legendre polynomials employed as the trial functions. This analysis method can be made more efficient by avoiding most of the computational effort spent on calculating contributions to the stiffness and mass matrices from each spar and rib. This is accomplished by replacing the wing inner-structure with an "equivalent" material that combines to the skin and whose properties are simulated by neural networks. The constitutive matrix, which relates the stress vector to the strain vector, and the density of the equivalent material are obtained by enforcing mass and stiffness matrix equities with rec,ard to the EPA in a least-square sense. Neural networks for the material properties are trained in terms of the design variables of the wing structure. Examples show that the present method, which can be called an Equivalent Skin Analysis (ESA) of the wing structure, is more efficient than the EPA and still fairly good results can be obtained. The present ESA is very promising to be used at the early stages of wing structure design.
Author
Aircraft Design; Design Analysis; Legendre Functions; Mindlin Plates; Neural Nets; Stiffness Matrix; Trapezoidal Wings; Skin (Structural Member)

20000024921 NASA Glenn Research Center, Cleveland, OH USA
Flutter and Forced Response Analyses of Cascades using a Two-Dimensional Linearized Euler Solver
Reddy, T. S. R., Toledo Univ., USA; Srivastava, R., Toledo Univ., USA; Mehmed, O., NASA Glenn Research Center, USA; November 1999; 32p; In English
Contract(s)/Grant(s): RTOP 523-26-13
Report No.(s): NASA/TM-1999-209633; E-11960; NAS 1.15:209633; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Flutter and forced response analyses for a cascade of blades in subsonic and transonic flow is presented. The structural model for each blade is a typical section with bending and torsion degrees of freedom. The unsteady aerodynamic forces due to bending and torsion motions. and due to a vortical gust disturbance are obtained by solving unsteady linearized Euler equations. The unsteady linearized equations are obtained by linearizing the unsteady nonlinear equations about the steady flow. The predicted unsteady aerodynamic forces include the effect of steady aerodynamic loading due to airfoil shape, thickness and angle of attack. The aeroelastic equations are solved in the frequency domain by coupling the un- steady aerodynamic forces to the aeroelastic solver MISER. The present unsteady aerodynamic solver showed good correlation with published results for both flutter and forced response predictions. Further improvements are required to use the unsteady aerodynamic solver in a design cycle.
Author
Euler Equations of Motion; Cascade Flow; Flutter Analysis; Aeroelasticity; Nonlinear Equations

13
GEOSCIENCES (GENERAL)

Includes general research topics related to the Earth sciences, and the specific areas of petrology, mineralogy, and general geology.

20000021335 NASA Goddard Space Flight Center, Greenbelt, MD USA
Lidar Altimeter Measurements of Canopy Structure: Methods and Validation for Closed Canopy, Broadleaf Forests
Harding, D. J., NASA Goddard Space Flight Center, USA; Lefsky, M. A., Forest Service, USA; Parker, G. G., Smithsonian Institution, USA; Blair, J. B., NASA Goddard Space Flight Center, USA; [1999]; 65p; In English; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

Lidar altimeter observations of vegetated landscapes provide a time-resolved measure of laser pulse backscatter energy from canopy surfaces and the underlying ground. Airborne lidar altimeter data was acquired using the Scanning Lidar Imager of Canopies by Echo Recovery (SLICER) for a successional sequence of four, closed-canopy, deciduous forest stands in eastern Maryland. The four stands were selected so as to include a range of canopy structures of importance to forest ecosystem function, including variation in the height and roughness of the outer-most canopy surface and the vertical organization of canopy stories and gaps. The character of the SLICER backscatter signal is described and a method is developed that accounts for occlusion of the laser energy by canopy surfaces, transforming the backscatter signal to a canopy height profile (CHP) that quantitatively represents the relative vertical distribution of canopy surface area. The transformation applies an increased weighting to the backscatter amplitude as a function of closure through the canopy and assumes a horizontally random distribution of the canopy components. SLICER CHPs, averaged over areas of overlap where lidar ground tracks intersect, are shown to be highly reproducible. CHP transects across the four stands reveal spatial variations in vegetation, at the scale of the individual 10 m diameter laser footprints, within and between stands. Averaged SLICER CHPs are compared to analogous height profile results derived from ground-based sightings to plant intercepts measured on plots within the four stands. Tbe plots were located on the segments of the lidar ground tracks from which averaged SLICER CHPs were derived, and the ground observations were acquired within two weeks of the SLICER data acquisition to minimize temporal change. The differences in canopy structure between the four stands is similarly described by the SLICER and ground-based CHP results, however a Chi-square test of similarity documents differences that are statistically significant. The differences are discussed in terms of measurement properties that define the smoothness of the resulting CHPs and Lidar Altimeter Measurements of Canopy Structure - Harding et al. canopy properties that may vertically bias the CHP representations of canopy structure. The statistical differences are most likely due to the more noisy character of the ground-based CHPs, especially high in the canopy where ground-based sightings are rare resulting in an underestimate of canopy surface area and height, and to departures from the assumption of horizontal randomness which bias the CHPs toward the observer (upward for SLICER and downward for ground-based CHPs). The results demonstrate that the SLICER observations reliably provide a measure of canopy structure that reveals ecologically interesting structural variations such as those characterizing a successional sequence of closed-canopy, broadleaf forest stands.
Author
Canopies (Vegetation); Forests; Pulsed Lasers; Radar Measurement; Altimeters; Laser Outputs

20000024927 NASA Goddard Space Flight Center, Greenbelt, MD USA
The Geoscience Laser Altimeter System (GLAS) for the ICESAT Mission
Abshire, James B., NASA Goddard Space Flight Center, USA; Sun, Xiao–Li, NASA Goddard Space Flight Center, USA; Ketchum, Eleanor A., NASA Goddard Space Flight Center, USA; Afzal, Robert S., NASA Goddard Space Flight Center, USA; Millar, Pamela S., NASA Goddard Space Flight Center, USA; [1999]; 2p; In English, 13-17 Dec. 1999, San Francisco, CA, USA; Sponsored by American Geophysical Union, USA; No Copyright; Avail: Issuing Activity, Hardcopy; Abstract Only

Accurate measurements of surface heights and atmospheric backscatter have been demonstrated with the SLA, MOLA and LITE space lidar. Recent MOLA measurements of the Mars surface have 40 cm resolution and have reduced the global uncertainty in Mars topography from a few km to approx. 10 m. GLAS is a next generation lidar being developed as part of NASA's Icesat Mission for Earth orbit . The GLAS design combines a 10 cm precision surface lidar with a sensitive dual wavelength cloud and aerosol lidar. GLAS will precisely measure the heights of the Earth's polar ice sheets, determine the height profiles of the Earth's land topography, and profile the vertical backscatter of clouds and aerosols on a global scale. GLAS will fly on a small dedicated spacecraft in a polar orbit at 598 km altitude with an inclination of 94 degrees. GLAS is scheduled to launch in summer 2001 and to operate continuously for a minimum of 3 years with a goal of 5 years. The primary mission for GLAS is to measure the seasonal and annual changes in the heights of the Greenland and Antarctic ice sheets. GLAS will measure the vertical distance to the ice sheet from orbit with 1064 nm pulses from a Nd:YAG laser at 40 Hz. Each 5 nsec wide laser pulse is used for a single range measurement. When over land GLAS will profile the heights of the topography and vegetation. The GLAS receiver uses a I m diameter telescope and a Si APD detector. The detector signal is sampled by an all digital receiver which records each surface

echo waveform with I nsec resolution and a stored echo record lengths of either 200, 400, or 600 samples. Analysis of the echo waveforms within the instrument permits discrimination between cloud and surface echoes. Ground based echo analysis permits precise ranging, determining the roughness or slopes of the surface as well as the vertical distributions of vegetation illuminated by the laser, Errors in knowledge of the laser beam pointing angle can bias height measurements of sloped surfaces. For surfaces with 2 deg. slopes, knowledge of pointing angle of the beam centroid to about 8 urad is required to achieve 10 cm height accuracy. GLAS uses a stellar reference system (SRS) to determine the pointing angle of each laser firing relative to inertial space. The SRS uses a high precision star camera oriented toward local zenith whose measurements are combined with a gyroscope to determine the inertial orientation of the SRS optical bench. The far field pattern of each laser pulse is measured with a laser reference system (LRS). Optically measuring each laser far field pattern relative to the star camera and gyroscope permits the angular offsets of each laser pulse to be determined. GLAS will also determine the vertical distributions of clouds and aerosols by measuring atmospheric backscatter profiles at both 1064 and 532 nm. The 1064 nm measurements use an analog detector and profile the height and vertical structure of thicker clouds. Measurements at 532 nm use new highly sensitive photon counting detectors, and measure the height distributions of very thin clouds and aerosol layers. With averaging these can be used to determine the height of the planetary boundary layer. The instrument design and expected performance will be discussed.
Author
Altimeters; Height; Ice; Laser Altimeters; Neodymium Lasers; Optical Radar

20000024796 Army Research Lab., Sensors Directorate, Adelphi, MD USA
An Overview of Hydrogen Generation and Storage for Low-Temperature PEM Fuel Cells *Final Report, Jun. - Aug. 1999*
Walker, Charles W., Jr.; Jiang, Rhongzhong; Chu, Deryn; Nov. 1999; 25p; In English
Report No.(s): AD-A372504; ARL-TR-2091; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Successful deployment of man portable, low temperature proton exchange membrane (PEM) fuel cells depends on finding a suitable hydrogen fuel that is easily stored and transported, inexpensive, readily available, safe, and practical for use in light and compact vessels. Because storage of hydrogen as a compressed gas in metal cylinders is inefficient and heavy, many alternative methods to store hydrogen have been investigated. This report lists several technologies for the storage and generation of hydrogen and provides brief descriptions.
DTIC
Fuel Cells; Jet Engine Fuels

20000024745 Illinois Univ., Urbana, IL USA
Future Atmospheric Perturbation from NO(x) Injection in the Lower Stratosphere
Wuebbles, Donald, Illinois Univ., USA; Models and Measurements Intercomparison 2; September 1999, pp. 449-491; In English; See also 20000024739; Original contains color illustrations; No Copyright; Avail: CASI; A03, Hardcopy; A04, Microfiche

The High Speed Civil Transport (HSCT) aircraft emissions studies provide a means to evaluate how the models being compared respond to a perturbation. The standard scenario of 500 HSCTS (Baughcum and Henderson, 1998) is used, but with a limited representation of the emissions so as to simplify the interpretation of the model results for the intercomparison. Emissions of nitrogen oxides corresponding to an Emissions Index of 10 are used in addition to two different assumptions about the effects of sulfur emissions. The first case assumes the background level of sulfuric aerosols (SAO) is left unchanged. The second case (SA1) assumes that the distribution of sulfuric aerosols have been modified by the aircraft sulfur emissions, with the distribution of aerosol surface area based on the AER model (Weisenstein et al., 1997). In this case, 50 % of the SO2 emitted by the aircraft is assumed to be immediately converted to sulfate particles in the plume. Neither case assumes any H2O aircraft emission. Figures of the zonal average of the HSCT NOx emissions used and the ratio of the aerosol surface area density for SA1 relative to SAO are included. All HSCT calculations were done relative to a "2015" background atmosphere assuming SAO sulfuric aerosol surface area. Nine models participated in the HSCT runs, including seven 2-D models and two 3-D models. The 3-D ECHAM3/CHEM model was only used for the SA1 case while the other eight models ran both cases.
Derived from text
Atmospheric Models; Nitrogen Oxides; Stratosphere; Perturbation; Exhaust Emission; Supersonic Transports; Plumes; Atmospheric Chemistry

20000025551 Naval Research Lab., Bay Saint Louis, MS USA
Navy Altimeter Data Requirements *Final Report*
Jacobs, Gregg A.; Barron, Charlie N.; Carnes, Michael R.; Fox, Daniel N.; Hurlburt, Harley E.; Nov. 10, 1999; 24p; In English
Report No.(s): AD-A371871; NRL/FR/7320--99-9696; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Navy requirements for altimeter data are driven mainly by the operational systems for mesoscale ocean circulation monitoring and acoustic prediction. Specification of requirements also considers development toward future systems that will provide tidal height and currents, regional circulation in semienclosed basins, and wave heights. We provide a short synopsis of present systems for describing the ocean environment based on altimeter data. Typical mesoscale time and length scales, determined from historical altimeter data, guide the specification of time and space resolution requirements for future altimeter systems. Accuracy requirements are based on the propagation of sea surface height errors into environmental estimates of the three-dimensional temperature and salinity fields and effects on sonar performance.
DTIC
Altimeters; Marine Environments; Oceanography

14
LIFE SCIENCES (GENERAL)

Includes general research topics related to plant and animal biology (non-human); ecology; microbiology; and also the origin, development, structure, and maintenance, of animals and plants in space and related environmental conditions.

20000025187 NASA Langley Research Center, Hampton, VA USA
Dynamics of Active Separation Control at High Reynolds Numbers
Pack, LaTunia G., NASA Langley Research Center, USA; Seifert, Avi, Tel-Aviv Univ., Ramat-Aviv, Israel; [2000]; 16p; In English; 38th; Aerospace Sciences, 10-13 Jan. 2000, Reno, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Report No.(s): AIAA Paper 2000-0409; Copyright Waived; Avail: CASI; A03, Hardcopy; A01, Microfiche

A series of active flow control experiments were recently conducted at high Reynolds numbers on a generic separated configuration. The model simulates the upper surface of a 20% thick Glauert-Goldschmied type airfoil at zero angle of attack. The flow is fully turbulent since the tunnel sidewall boundary layer flows over the model. The main motivation for the experiments is to generate a comprehensive data base for validation of unsteady numerical simulation as a first step in the development of a CFD design tool, without which it would not be possible to effectively utilize the great potential of unsteady flow control. This paper focuses on the dynamics of several key features of the baseline as well as the controlled flow. It was found that the thickness of the upstream boundary layer has a negligible effect on the flow dynamics. It is speculated that separation is caused mainly by the highly convex surface while viscous effects are less important. The two-dimensional separated flow contains unsteady waves centered on a reduced frequency of 0.9, while in the three dimensional separated flow, frequencies around a reduced frequency of 0.3 and 1 are active. Several scenarios of resonant wave interaction take place at the separated shear-layer and in the pressure recovery region. The unstable reduced frequency bands for periodic excitation are centered on 1.5 and 5, but these reduced frequencies are based on the length of the baseline bubble that shortens due to the excitation. The conventional works well for the coherent wave features. Reproduction of these dynamic effects by a numerical simulation would provide benchmark validation.
Author
Active Control; Airfoils; Boundary Layer Flow; Fluid Dynamics; High Reynolds Number; Three Dimensional Flow; Turbulence; Zero Angle of Attack

20000026303 Wyle Labs., Inc., Life Sciences, Houston, TX USA
KC-135 and Other Microgravity Simulations
Noel, Skinner C., Wyle Labs., Inc., USA; August 1999; 163p; In English; See also 20000026304 through 20000026336; Original contains color illustrations
Contract(s)/Grant(s): NAS9-97005
Report No.(s): NASA/CR-1999-208922; NAS 1.26:208922; No Copyright; Avail: CASI; A08, Hardcopy; A02, Microfiche

This document represents a summary of medical and scientific evaluations conducted aboard the KC-135 from June 20, 1998 to June 20, 1999. Included is a general overview of KC-135 activities manifested and coordinated by the Life Sciences Research Laboratories. A collection of brief reports that describes tests conducted aboard the KC-135 follows the overview. Principal investigators and test engineers contributed significantly to the content of the report describing their particular experiment or hardware evaluation. Although this document follows general guidelines, each report format may vary to accommodate

differences in experiment design and procedures. This document concludes with an appendix that provides background information concerning the KC-135 and the Reduced-Gravity Program.
Author
C-135 Aircraft; Experiment Design; Life Sciences; Microgravity; Weightlessness Simulation; Parabolic Flight; Aerospace Medicine; Bioastronautics

20000026336 NASA Johnson Space Center, Houston, TX USA
Background Information About the KC-135 and the Reduced-Gravity Program
KC-135 and Other Microgravity Simulations; August 1999, pp. a-2; In English; See also 20000026303; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche

The Reduced-Gravity Program, operated by the NASA/Johnson Space Center (JSC), provides engineers, scientists, and astronauts alike, a unique opportunity to perform testing and training in a weightless environment but without ever having to leave the confines of the earth's orbit. Given the frequency of Space Shuttle missions and the anticipated construction and eventual habitation of the New International Space Station, the Reduced-Gravity Program provides a truly ideal environment to test and evaluate space hardware and experimental procedures prior to launch. The Reduced-Gravity Program was established in 1959 to investigate the reactions of humans and hardware during operations in a weightless environment. A specially modified KC-135 turbojet (KC-135A), flying parabolic arcs, produces periodic episodes of weightlessness lasting 20-25 secs. The KC-135 is sometimes also flown to provide short periods of lunar (1/6) and Martian (1/3) gravity.
Derived from text
C-135 Aircraft; Gravitation; Microgravity; Parabolic Flight; Weightlessness Simulation

20000021430 Institute for Human Factors TNO, Soesterberg, Netherlands
The Feasibility of a Three-Crew Concept for the NFH90: Exploring Workload Bottlenecks (TNO-HFRI Part of Study) ***Final Report De Haalbaarheid van een Drie-Mans Concept voor de NFH90: Onderzoek Naar Werkbelastingsproblemen (TNO-TM-Deel)***
Veltman, J. A., Institute for Human Factors TNO, Netherlands; Nov. 18, 1999; 28p; In English
Contract(s)/Grant(s): A96/KM/327; TNO Proj. 788.1
Report No.(s): TD99-0365; TNO-TM-99-A075; Copyright; Avail: Issuing Activity

An experiment was conducted by the TNO Human Factors Research Institute and the National Aerospace Laboratory (NLR) in the tactical trainer of the Orion in order to get insight into the tasks and the workload of tactical coordinators (TACCOs). This report presents the results of the TNO part of the study only. The Lynx helicopter will be replaced by the NFH90 within a few years. To determine the feasibility of a three crew concept, similar to the Lynx helicopter, several studies commissioned by the Royal Netherlands Navy are (and will be) conducted to get insight into the workload of the future crew. The TACCO in the Orion works with a display for tactical information. Because the TACCO in the NFH90 will also work with information displays, the present study focuses on the workload and tasks of an Orion TACCO. During an anti submarine warfare (ASW) and anti surface warfare (ASUW) mission the workload was measured of an experienced and inexperienced TACCO with physiological measures (heart rate, respiration and eye blinks). The missions were recorded on videotape. After the missions the TACCOs analysed the mission by means of a special purpose computer program. They indicated the moments during which tasks were executed and gave ratings of the workload and the amount of routine handling each minute. Together with the physiological recordings, this provided time lines of tasks and workload. The data indicated that the TACCOs had the highest workload before and directly after an attack in an ASW mission. The joining segment of the ASW mission and an ASUW mission were far less demanding. The attack during an ASW mission was demanding because this situation is always unique and therefore, no standard procedures can be obtained. Further- more, the TACCOs have to interpret a lot of information with a high level of uncertainty. The work of the TACCO in the NFH90 will change from actively controlling instruments and retrieving information to managing large amounts of information. The workload of the TACCO in the NFH90 will depend on the level of equipment automation that can be obtained and the level of management that is required for adequate task performance. Future studies will address these issues.
Author
Helicopters; Human Factors Engineering; Physiology; Workloads (Psychophysiology)

20000025767 Civil Aeromedical Inst., Oklahoma City, OK USA
The Human Factors Analysis and Classification System-HFACS ***Final Report***
Shappell, Scott A., Civil Aeromedical Inst., USA; Wiegmann, Douglas A., Illinois Univ., USA; February 2000; 22p; In English
Contract(s)/Grant(s): AAM-A-00-HRR-520; 99-G-006
Report No.(s): DOT/FAA/AM-00/7; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Human error has been implicated in 70 to 80% of all civil and military aviation accidents. Yet, most accident reporting systems are not designed around any theoretical framework of human error. As a result, most accident databases are not conducive to a traditional human error analysis, making the identification of intervention strategies onerous. What is required is a general human error framework around which new investigative methods can be designed and existing accident databases restructured. Indeed, a comprehensive human factors analysis and classification system (HFACS) has recently been developed to meet those needs. Specifically, the HFACS framework has been used within the military, commercial, and general aviation sectors to systematically examine underlying human causal factors and to improve aviation accident investigations. This paper describes the development and theoretical underpinnings of HFACS in the hope that it will help safety professionals reduce the aviation accident rate through systematic, data-driven investment strategies and objective evaluation of intervention programs
Author
Aircraft Accident Investigation; Aircraft Accidents; Data Bases; Human Factors Engineering; Human Performance; Pilot Error

15
MATHEMATICAL AND COMPUTER SCIENCES (GENERAL)

Includes general topics and overviews related to mathematics and computer science.

20000021504 NASA Marshall Space Flight Center, Huntsville, AL USA
A Collaborative Analysis Tool for Integrated Hypersonic Aerodynamics, Thermal Protection Systems, and RBCC Engine Performance for Single Stage to Orbit Vehicles
Stanley, Thomas Troy, International Space Systems, Inc., USA; Alexander, Reginald, NASA Marshall Space Flight Center, USA; Landrum, Brian, Alabama Univ., USA; [2000]; 2p; In English; Joint Propulsion, 16-19 Jul. 2000, Huntsville, AL, USA; No Copyright; Avail: Issuing Activity, Hardcopy; Abstract Only

Presented is a computer-based tool that connects several disciplines that are needed in the complex and integrated design of high performance reusable single stage to orbit (SSTO) vehicles. Every system is linked to every other system, as is the case of SSTO vehicles with air breathing propulsion, which is currently being studied by NASA. An RBCC propulsion system integrates airbreathing and rocket propulsion into a single engine assembly enclosed within a cowl or duct. A typical RBCC propulsion system operates as a ducted rocket up to approximately Mach 3. Then there is a transition to a ramjet mode for supersonic-to-hypersonic acceleration. Around Mach 8 the engine transitions to a scramjet mode. During the ramjet and scramjet modes, the integral rockets operate as fuel injectors. Around Mach 10-12 (the actual value depends on vehicle and mission requirements), the inlet is physically closed and the engine transitions to an integral rocket mode for orbit insertion. A common feature of RBCC propelled vehicles is the high degree of integration between the propulsion system and airframe. At high speeds the vehicle forebody is fundamentally part of the engine inlet, providing a compression surface for air flowing into the engine. The compressed air is mixed with fuel and burned. The combusted mixture must be expanded to an area larger than the incoming stream to provide thrust. Since a conventional nozzle would be too large, the entire lower after body of the vehicle is used as an expansion surface. Because of the high external temperatures seen during atmospheric flight, the design of an airbreathing SSTO vehicle requires delicate tradeoffs between engine design, vehicle shape, and thermal protection system (TPS) sizing in order to produce an optimum system in terms of weight (and cost) and maximum performance. to adequately determine the performance of the engine/vehicle, the Hypersonic Flight Inlet Model (HYFIM) module was designed to interface with the RBCC engine model. HYFIM performs the aerodynamic analysis of forebodies and inlet characteristics of RBCC powered SSTO launch vehicles. HYFIM is applicable to the analysis of the ramjet/scramjet engine operations modes (Mach 3-12), and provides estimates of parameters such as air capture area, shock-on-lip Mach number, design Mach number, compression ratio, etc., based on a basic geometry routine for modeling axisymmetric cones, 2-D wedge geometries. HYFIM also estimates the variation of shock layer properties normal to the forebody surface. The thermal protection system (TPS) is directly linked to determination of the vehicle moldline and the shaping of the trajectory. Thermal protection systems to maintain the structural integrity of the vehicle must be able to mitigate the heat transfer to the structure and be lightweight. Herein lies the interdependency, in that as the vehicle's speed increases, the TPS requirements are increased. and as TPS masses increase the effect on the propulsion system and all other systems is compounded. The need to analyze vehicle forebody and engine inlet is critical to be able to design the RBCC vehicle. to adequately determine insulation masses for an RBCC vehicle, the hypersonic aerodynamic environment and aeroheating loads must be calculated and the TPS thicknesses must be calculated for the entire vehicle. to accomplish this an ascent or reentry trajectory is obtained using the computer code Program to Optimize Simulated Trajectories (POST). The trajectory is then used to calculate the convective heat rates on several locations on the vehicles using the Miniature Version of the JA70 Aerodynamic Heating Computer Program (MINIVER). Once the heat rates are defined for each body point on the vehicle, then insulation thicknesses that are required to maintain the vehicle within structural limits are calculated using Systems Improved Numerical

Differencing Analyzer (SINDA) models. If the TPS masses are too heavy for the performance of the vehicle the process may be repeated altering the trajectory or some other input to reduce the TPS mass. E-PSURBCC is an "engine performance" model and requires the specification of inlet air static temperature and pressure as well as Mach number (which it pulls from the HYFIM and POST trajectory files), and calculates the corresponding stagnation properties. The engine air flow path geometry includes inlet, a constant area section where the rocket is positioned, a subsonic diffuser, a constant area afterburner, and either a converging nozzle or a converging-diverging nozzle. The current capabilities of E-PSURBCC ejector and ramjet mode treatment indicated that various complex flow phenomena including multiple choking and internal shocks can occur for combinations of geometry/flow conditions. For a given input deck defining geometry/flow conditions, the program first goes through a series of checks to establish whether the input parameters are sound in terms of a solution path. If the vehicle/engine performance fails mission goals, the engineer is able to collaboratively alter the vehicle moldline to change aerodynamics, or trajectory, or some other input to achieve orbit. The problem described is an example of the need for collaborative design and analysis. RECIPE is a cross-platform application capable of hosting a number of engineers and designers across the Internet for distributed and collaborative engineering environments. Such integrated system design environments allow for collaborative team design analysis for performing individual or reduced team studies. To facilitate the larger number of potential runs that may need to be made, RECIPE connects the computer codes that calculate the trajectory data, aerodynamic data based on vehicle geometry, heat rate data, TPS masses, and vehicle and engine performance, so that the output from each tool is easily transferred to the model input files that need it.
Author
Air Breathing Engines; Computer Programs; Computer Techniques; Mathematical Models; Ramjet Engines; Single Stage to Orbit Vehicles; Supersonic Combustion Ramjet Engines; Systems Engineering; Thermal Analysis; Design Analysis

20000023235 NASA Goddard Space Flight Center, Greenbelt, MD USA
One GigaSample Per Second Data Acquisition using Available Gate Array Technology
Wagner, K.W., NASA Goddard Space Flight Center, USA; [1999]; 4p; In English; Military and Aerospace Applications of Programmable Devices and Technologies, 28-30 Sep. 1999, Laurel, MD, USA; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

A new National Aeronautics and Space Administration instrument forced demanding requirements upon its altimeter digitizer system. Eight-bit data would be generated at a rate of one billion samples per second. NASA had never before attempted to capture such high-speed data in the radiation, low-power, no-convective-cooling, limited-board-area environment of space. This presentation describes how the gate array technology available at the time of the design was used to implement this one gigasample per second data acquisition system
Author
Data Acquisition; NASA Programs; Altimeters; Analog to Digital Converters; Aerospace Environments; Laser Arrays

20000025259 NASA Glenn Research Center, Cleveland, OH USA
SmaggIce User Guide, 1.0
Baez, Marivell, NASA Glenn Research Center, USA; Vickerman, Mary, NASA Glenn Research Center, USA; Choo, Yung, NASA Glenn Research Center, USA; February 2000; 50p; In English
Contract(s)/Grant(s): RTOP 548-20-23
Report No.(s): NASA/TM-2000-209793; NAS 1.15:209793; E-12083; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

SmaggIce (Surface Modeling and Grid Generation for Iced Airfoils) is one of NASNs aircraft icing research codes developed at the Glenn Research Center. It is a software toolkit used in the process of aerodynamic performance prediction of iced airfoils. It includes tools which complement the 2D grid-based Computational Fluid Dynamics (CFD) process: geometry probing; surface preparation for gridding: smoothing and re-discretization of geometry. Future releases will also include support for all aspects of gridding: domain decomposition; perimeter discretization; grid generation and modification.
Derived from text
Software Development Tools; Computational Fluid Dynamics; User Manuals (Computer Programs); Aircraft Icing; Grid Generation (Mathematics); Airfoils

20000025389 NASA Langley Research Center, Hampton, VA USA
Comparison of Integrated Analysis Methods for Two Model Scenarios
Amundsen, Ruth M., NASA Langley Research Center, USA; Ninth Thermal and Fluids Analysis Workshop Proceedings; November 1999, pp. 37-48; In English; See also 20000025387; No Copyright; Avail: CASI; A03, Hardcopy; A03, Microfiche

Integrated analysis methods have the potential to substantially decrease the time required for analysis modeling. Integration with computer aided design (CAD) software can also allow a model to be more accurate by facilitating import of exact design geometry. However, the integrated method utilized must sometimes be tailored to the specific modeling situation, in order to make the process most efficient. Two cases are presented here that illustrate different processes used for thermal analysis on two different models. These examples are used to illustrate how the requirements, available input, expected output, and tools available all affect the process selected by the analyst for the most efficient and effective analysis.
Author
Computer Aided Design; Systems Integration; Applications Programs (Computers); Aircraft Models; Hypersonic Aircraft

20000021014 Department of Defense, Office of Inspector General, Arlington, VA USA
Year 2000 Compliance of Selected Air Mobility Command Systems
Apr. 13, 1999; 17p; In English
Contract(s)/Grant(s): Proj. 9CC-0086.01
Report No.(s): AD-A367048; IG/DOD-99-134; No Copyright; Avail: CASI; A01, Microfiche; A03, Hardcopy

This is one in a series of reports being issued by the Inspector General, DoD, in accordance with an informal partnership with the Chief Information Officer, DoD, to monitor efforts to address the year 2000 computing challenge. For a listing of audit projects addressing the issue, see the year 2000 webpage on the IGnet at www.ignet.gov. The overall audit objective was to assess the status of selected Military Department and Defense Agency mission-critical systems, identified by U.S. Pacific Command and U.S. Forces Korea as being of particular importance to them, in attaining compliance with year 2000 conversion requirements. Specifically, we reviewed the progress of each system towards year 2000 compliance, testing and integration of modifications, and contingency plans. For this report, we reviewed two Air Mobility Command managed systems, the Command and Control Information Processing System and the Global Air Transportation Execution System, operated within the U.S. Pacific Command area of responsibility.
DTIC
Air Transportation; Information Systems; Systems Management; Computer Program Integrity

20000024884 NASA Goddard Space Flight Center, Greenbelt, MD USA
Flight Dynamics Analysis Branch End of Fiscal Year 1999 Report
Stengle, Thomas, NASA Goddard Space Flight Center, USA; Flores–Amaya, Felipe, NASA Goddard Space Flight Center, USA; October 1999; 37p; In English; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This document summarizes the major activities and accomplishments carried out by the Goddard Space Flight Center (GSFC)'s Flight Dynamics Analysis Branch (FDAB), Code 572, in support of flight projects and technology development initiatives in Fiscal Year (FY) 1999. The document is intended to serve as both an introduction to the type of support carried out by the FDAB (Flight Dynamics Analysis Branch), as well as a concise reference summarizing key analysis results and mission experience derived from the various mission support roles assumed over the past year. The major accomplishments in the FDAB in FY99 were: 1) Provided flight dynamics support to the Lunar Prospector and TRIANA missions among a variety of spacecraft missions; 2) Sponsored the Flight Mechanics Symposium; 3) Supported the Consultative Committee for Space Data Systems (CCSDS) workshops; 4) Performed numerous analyses and studies for future missions; 5) Started the Flight Dynamics Analysis Branch Lab for in-house mission analysis and support; and 6) Complied with all requirements in support of GSFC IS09000 certification.
Derived from text
Aerodynamics; Earth Observing System (EOS); Flight Mechanics; Dynamical Systems

16
PHYSICS (GENERAL)

Includes general research topics related to mechanics, kinetics, magnetism, and electrodynamics.

20000021244 Sikorsky Aircraft, Stratford, CT USA
Rotorcraft Noise Abatement Flight Path Modeling
Murty, Hema, Sikorsky Aircraft, USA; Berezin, Charles R., Sikorsky Aircraft, USA; February 2000; 78p; In English
Contract(s)/Grant(s): NAS1-20097; RTOP 581-20-31-01
Report No.(s): NASA/CR-2000-209353; NAS 1.26:209353; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

This report addresses development of a rotor state/trim modeling capability for noise modeling of decelerating rotorcraft approaches. The resulting technique employs discretization of the descent trajectory as multiple steady state segments for input to CAMRAD.Mod 1 to predict rotor states for acoustic analysis. Deceleration is included by modifying the CAMRAD.Mod 1 free flight trim options to allow trim to the specified acceleration/deceleration components.
Author
Noise Reduction; Flight Paths; Applications Programs (Computers); Mathematical Models; Sikorsky Whirlwind Helicopter; Flight Tests

20000025213 Pennsylvania State Univ., Dept. of Aerospace Engineering, University Park, PA USA
Summary of Research Report
Long, Lyle N., Pennsylvania State Univ., USA; Dec. 15, 1999; 12p; In English
Contract(s)/Grant(s): NAG1-2093; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This report describes a project to predict ducted fan noise using massively parallel computers. The investigators are part of a larger team of researchers, most of whom are working at NASA Langley Research Center. The portion of the project described below not only stands alone as an individual research project, it also compliments the NASA Langley work. The write-up included in this report is relatively brief, since the details are described in technical papers.
Derived from text
Ducted Fans; Fan Blades; Aerodynamic Noise; Noise Prediction; Noise Measurement; Aircraft Noise

20000025236 NASA Glenn Research Center, Cleveland, OH USA
Noise Computation of a Shock-Containing Supersonic Axisymmetric Jet by the CE/SE Method
Loh, Ching Y., Taitech, Inc., USA; Hultgren, Lennart S., NASA Glenn Research Center, USA; Chang, Sin–Chung, NASA Glenn Research Center, USA; Jorgenson, Philip C. E., NASA Glenn Research Center, USA; December 1999; 24p; In English; 38th; 38th Aerospace Sciences Meeting, 10-13 Jan. 2000, Reno, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Contract(s)/Grant(s): RTOP 522-81-11
Report No.(s): NASA/TM-1999-209658; NAS 1.15:209658; AIAA Paper 2000-0475; E-12029; Copyright Waived; Avail: CASI; A03, Hardcopy; A01, Microfiche

The space-time conservation element solution element (CE/SE) method is employed to numerically study the near-field of a typical under-expanded jet. For the computed case-a circular jet with Mach number M(j) = 1.19-the shock-cell structure is in good agreement with experimental results. The computed noise field is in general agreement with the experiment, although further work is needed to properly close the screech feedback loop.
Author
Supersonic Jet Flow; Aeroacoustics; Jet Aircraft Noise; Mechanical Shock; Noise Measurement

20000020871 Alfa Romeo S.p.A., Research and Development Dept., Naples, Italy
Numerical Predictions and Experimental Measurements of Radiative Heat Transfer in Gas Turbine Combustors
DiMartino, P., Alfa Romeo S.p.A., Italy; Cinque, G., Alfa Romeo S.p.A., Italy; Gas Turbine Engine Combustion, Emissions and Alternative Fuels; June 1999, pp. 49-1 - 49-13; In English; See also 20000020829; Copyright Waived; Avail: CASI; A03, Hardcopy; A06, Microfiche

The present paper is concerned with the calculation of the flowfield heat transfer and turbulent combustion processes inside a single annular reverse-flow gas turbine combustor for aircraft engines. Numerical analysis has been carried out by using a CFD home computer code based on finite-volume method and body-conforming non-orthogonal structured grids. Emphasis has been put on the evaluation of wall temperatures distribution, which was assumed in previous works. A comparison with experimental measurements obtained by means of thermal paints has also been performed. A method to evaluate wall temperatures and radiative heat fluxes is described. No attempt has been made to account for the presence of soot First results obtained seem encouraging in that the trend of calculations is in good agreement with experiments. While an amount of work remains to be done in improving physical models, this study shows that CFD can be used as a tool in studying the main features of a gas turbine combustor and in correlation important design parameters.
Author
Radiative Heat Transfer; Gas Turbine Engines; Flow Distribution; Finite Volume Method; Turbulent Combustion; Combustion Chambers; Wall Temperature

17
SOCIAL AND INFORMATION SCIENCES (GENERAL)

Includes general research topics related to sociology; educational programs and curricula.

20000025197 NCI Information Systems, Inc., Hanover, MD USA
NASA Scope and Subject Category Guide
January 2000; 138p; In English; Requirements: MS Internet Explorer 4.0 or higher; or Netscape 4.0 or higher (Does not require an active Internet connection for basic functions.)
Contract(s)/Grant(s): NAS1-96010
Report No.(s): NASA/SP-2000-7603; NAS 1.21:7603; No Copyright; Avail: CASI; A25, CD-ROM; A07, Hardcopy

This guide provides a simple but effective tool to assist aerospace information analysts and database builders in the high-level subject classification of technical materials. Each of the 76 subject categories comprising the classification scheme is presented with a description of category scope, a listing of subtopics, cross references, and an indication of particular areas of NASA interest. The guide also includes an index of over 2,200 specific research topics cross referenced to the subject categories. The CD-ROM version hyperlinks this index to the subject categories. In addition to subject classification, the guide can serve as an aid to searching databases that use the classification scheme, and is also an excellent selection guide for those involved in the acquisition of aerospace literature. The CD-ROM includes the guide in PDF for printing.
Author
Classifications; Categories; Information Management; Aerospace Sciences; Aerospace Engineering; Aeronautics; Astronautics

20000025325 Civil Aeromedical Inst., Oklahoma City, OK USA
Enhancing GPS Receiver Certification by Examining Relevant Pilot-Performance Databases *Final Report*
Joseph, Kurt M., Civil Aeromedical Inst., USA; Jahns, Dieter W., SynerTech Associates, USA; February 2000; 14p; In English
Report No.(s): DOT/FAA/AM-00/4; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The rapid introduction of Global Positioning System (GPS) receivers for airborne navigation has outpaced the capacity of international aviation authorities to resolve human factors issues that concern safe and efficient use of such devices. Current certification technical standards appear to have had little impact on promoting the design of standardized receiver architectures, interfaces and operating manuals -- despite evidence from a variety of sources that lack of standardization may undermine safety. This paper explores the relationship between existing human factors data relevant to GPS-interface design and incident/accident databases, which are a rich source of information and serve to highlight the safety-critical nature of GPS-receiver interface issues. An approach to expanding the role of human factors assessments in the certification of GPS receivers is briefly summarized.
Author
Global Positioning System; Human Factors Engineering; Receivers; Standardization; Aircraft Instruments; Flight Control; Navigation; Flight Paths

20000025462 NCI Information Systems, Inc., Hanover, MD USA
Aerospell Supplemental Spell Check File
January 2000; In English; 1 diskette: high density, double sided; IBM formatted
Contract(s)/Grant(s): NAS1-96010; No Copyright; Avail: CASI; A09, Diskette

Aerospell is a supplemental spell check file that can be used as a resource for researchers, writers, editors, students, and others who compose scientific and technical texts. The file extends the general spell check dictionaries of word processors by adding more than 13,000 words used in a broad range of aerospace and related disciplines.
CASI
Dictionaries; Editing; Word Processing; Words (Language); Nomenclatures; Aerospace Sciences; Astronautics; Aeronautics; Science; Engineering

20000026924 NCI Information Systems, Inc., NASA Center for AeroSpace Information, Hanover, MD USA
NASA Thesaurus, Volume 1, Hierarchical Listing with Definitions
January 2000; In English; PDF format
Report No.(s): NASA/SP-2000-7501/VOL1-2; NAS 1.21:7501/VOL1-2; NONP/NASA-CD-2000031248; No Copyright; Avail: CASI; E07, CD-ROM; Includes volumes 1 and 2. For hardcopy version see 19980010926.

The NASA Thesaurus contains the authorized subject terms by which the documents in the NASA STI Databases are indexed and retrieved. The scope of this controlled vocabulary includes not only aerospace engineering, but all supporting areas of engineering and physics, the natural space sciences (astronomy, astrophysics, planetary science), Earth sciences, and to some

extent, the biological sciences. Volume 1 - Hierarchical Listing With Definitions contains over 17,900 subject terms, 3,948 definitions, and more than 4,000 USE cross references. The Hierarchical Listing presents full hierarchical structure for each term along with 'related term' lists, and can serve as an orthographic authority. Volume 2 - Rotated Term Display is a ready-reference tool which provides over 21,500 additional 'access points' to the thesaurus terminology. It contains the postable and nonpostable terms found in the Hierarchical Listing arranged in a KWIC (key-word-in-context) index. This CD-ROM version of the NASA Thesaurus is in PDF format and is updated to the current year of purchase.
CASI
Hierarchies; Thesauri; Terminology; Aerospace Sciences; Aeronautics; Astronomy; KWIC Indexes

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SPACE SCIENCES (GENERAL)

Includes general research topics related to the natural space sciences.

20000025361 NASA Ames Research Center, Moffett Field, CA USA
Aeolian Sand Transport in the Planetary Context: Respective Roles of Aerodynamic and Bed-Dilatancy Thresholds
Marshall, J. R., Search for Extraterrestrial Intelligence Inst., USA; Borucki, J., NASA Ames Research Center, USA; Bratton, C., Search for Extraterrestrial Intelligence Inst., USA; Studies of Mineralogical and Textural Properties of Martian SOIl: An Exobiological Perspective; September 1999, pp. 18-20; In English; 29th; Lunar and Planetary Science, 16-20 Mar. 1998, Houston, TX, USA; See also 20000025351
Contract(s)/Grant(s): NCC2-926; No Copyright; Abstract Only; Avail. from CASI only as part of the entire parent document

The traditional view of aeolian sand transport generally estimates flux from the perspective of aerodynamic forces creating the airborne grain population, although it has been recognized that "reptation" causes a significant part of the total airborne flux; reptation involves both ballistic injection of grains into the air stream by the impact of saltating grains as well as the "nudging" of surface grains into a creeping motion. Whilst aerodynamic forces may initiate sand motion, it is proposed here that within a fully-matured grain cloud, flux is actually governed by two thresholds: an aerodynamic threshold, and a bed-dilatancy threshold. It is the latter which controls the reptation population, and its significance increases proportionally with transport energy. Because we only have experience with terrestrial sand transport, extrapolations of aeolian theory to Mars and Venus have adjusted only the aerodynamic factor, taking gravitational forces and atmospheric density as the prime variables in the aerodynamic equations, but neglecting reptation. The basis for our perspective on the importance of reptation and bed dilatancy is a set of experiments that were designed to simulate sand transport across the surface of a martian dune. Using a modified sporting crossbow in which a sand-impelling sabot replaced the bolt-firing mechanism, individual grains of sand were fired at loose sand targets with glancing angles typical of saltation impact; grains were projected at about 80 m/s to simulate velocities commensurate with those predicted for extreme martian aeolian conditions. The sabot impelling method permitted study of individual impacts without the masking effect of bed mobilization encountered in wind-tunnel studies. At these martian impact velocities, grains produced small craters formed by the ejection of several hundred grains from the bed. Unexpectedly, the craters were not elongated, despite glancing impact; the craters were very close to circular in planform. High-speed photography showed them to grow in both diameter and depth after the impactor had ricochetted from the crater site. The delayed response of the bed was "explosive" in nature, and created a miniature ejecta curtain spreading upward and outward for many centimeters for impact of 100-300 micron-diameter grains into similar material. Elastic energy deposited in the bed by the impacting grain creates a subsurface stress regime or "quasi-Boussinesq" compression field. Elastic recovery of the bed occurs by dilatancy; shear stresses suddenly convert the grains from closed to open packing, and grains are consequently able to eject themselves forcefully from the impact site. Random jostling of the grains causes radial homogenization of stress vectors and a resulting circular crater. There is a great temptation to draw parallels with cratering produced by meteorite impacts, but a rigorous search for common modelling ground between the two phenomena has not been conducted at this time. For every impact of an aerodynamically energized grain, there are several hundred grains ejected into the wind for the high-energy transport that might occur on Mars. Many of these grains will themselves become subject to the boundary layer's aerodynamic lift forces (their motion will not immediately die and add to the creep population), and these grains will become indistinguishable from those lifted entirely by aerodynamic forces. As each grain impacts the bed, it will eject even more grains into the flow. A cascading effect will take place, but because it must be finite in its growth, damping will occur as the number of grains set in motion causes mid-air collisions that prevent much of the impact energy from reaching the surface of the bed -thus creating a dynamic equilibrium in a high-density saltation cloud. It is apparent that for a given impact energy, the stress field permits a smaller volume of grains to convert to open packing as the size of the bed grains increases, or as the energy of the "percussive" grain decreases (by decrease in velocity or mass). Thus, the mass of the "repercussive" grain population that is ejected from the impact site becomes a function of the scale of the stress field in relation to the scale of the bed

material (self-similarity being applicable if both bed size and energy are simultaneously adjusted). In other words, in a very high energy aeolian system where an aerodynamically raised grain can ballistically raise many more grains, the amount of material lifted into the wind becomes largely a function of a dilatancy threshold. If this threshold is exceeded, grains are repercussively injected into the saltation cloud. The "dilatancy threshold" may be defined in terms of the saltation percussive force required to convert the bed, through elastic response, from a closed to an open packing system. If open packing cannot be created, the grains cannot escape from the impact site, even though the elastic deformation and percussive force may be able to reorganize the grains with respect to one another. As the crossbow experiments showed, for an ever-increasing bed grain size, a point is reached when no material can be moved because the energy of the percussive grain is insufficient to dilate the relatively coarse bed. Although this seems to be stating the obvious -- that too little energy will not cause the bed to splash -- the consequences of exceeding the "splash threshold" by dilatancy are not so obvious for high-energy aeolian transport. It is noted that the force required to elastically dilate the bed has to overcome Coulombic grain attractions such as dipole-dipole coupling, dielectric, monopole, contact-induced dipole attractions, van der Waals forces, molecular monolayer capillary forces, as well as the mechanical interlocking frictional resistance of the grains. On Mars, it is predicted that the dilatancy threshold may be the prime control of grain flux. Additional information is contained in the original.
Author
Aerodynamic Forces; Mars (Planet); Sands; Sediment Transport; Wind Effects; Dust Storms; Stretching

20000025386 NASA Johnson Space Center, Houston, TX USA
Interaction of Space Suits with Windblown SOIl: Preliminary Mars Wind Tunnel Results
Marshall, J., Search for Extraterrestrial Intelligence Inst., USA; Bratton, C., Search for Extraterrestrial Intelligence Inst., USA; Kosmo, J., NASA Johnson Space Center, USA; Trevino, R., NASA Johnson Space Center, USA; Studies of Mineralogical and Textural Properties of Martian SOIl: An Exobiological Perspective; September 1999, pp. 79-80; In English; 30th; Lunar and Planetary Science, 15-19 Mar. 1999, Houston, TX, USA; See also 20000025351
Contract(s)/Grant(s): NCC2-926; No Copyright; Abstract Only; Avail. from CASI as part of the entire parent document

Experiments in the Mars Wind Tunnel at NASA Ames Research Center show that under Mars conditions, spacesuit materials are highly susceptible to dust contamination when exposed to windblown soil. This effect was suspected from knowledge of the interaction of electrostatically adhesive dust with solid surfaces in general. However, it is important to evaluate the respective roles of materials, meteorological and radiation effects, and the character of the soil. The tunnel permits evaluation of dust contamination and sand abrasion of space suits by simulating both pressure and wind conditions on Mars. The long-term function of space suits on Mars will be primarily threatened by dust contamination. Lunar EVA activities caused heavy contamination of space suits, but the problem was never seriously manifest because of the brief utilization of the suits, and the suits were never reused. Electrostatically adhering dust grains have various detrimental effects: (1) penetration and subsequent wear of suit fabrics, (2) viewing obscuration through visors and scratching/pitting of visor surfaces, (3) penetration, wear, and subsequent seizing-up of mechanical suit joints, (4) changes in albedo and therefore of radiation properties of external heat-exchanger systems, (5) changes in electrical conductivity of suit surfaces which may affect tribocharging of suits and create spurious discharge effects detrimental to suit electronics/radio systems. Additional information is contained in the original.
Derived from text
Mars Atmosphere; Simulation; Space Suits; Visors; Wind Tunnels; Mars (Planet); Dust; Dust Storms; Sands

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GENERAL

Includes aeronautical, astronautical, and space science related histories, biographies, and pertinent reports too broad for categorization; histories or broad overviews of NASA programs such as Apollo, Gemini, and Mercury spacecraft, Earth Resources Technology Satellite (ERTS), and Skylab; NASA appropriations hearings.

20000025461 NCI Information Systems, Inc., Hanover, MD USA
NASA Aerospace Science and Technology Dictionary
January 2000; In English; 1 CD-ROM; Requirements: MS Internet Explorer 4.0 or higher; or Netscape 2.0 or higher (Does not require an active Internet connection for basic functions.)
Contract(s)/Grant(s): NAS1-96010; No Copyright; Avail: CASI; E07, CD-ROM

Containing over 10,000 definitions, the AS&T Dictionary is a CD-ROM ready-reference tool for assisting researchers, educators, students, technical writers, and others in understanding and using aerospace terminology. This resource brings together definitions from over 20 different sources including the NASA Thesaurus and the Dictionary of Technical Terms For Aerospace

Use. The AS&T Dictionary covers terminology in aviation and space engineering and the natural space sciences (including astronomy, astrophysics, and planetology), as well as terminology from supporting areas of engineering, physics, chemistry, and the Earth and life sciences. In the core aerospace areas, the contents represent both current and historical terminology from the past 60 years of aviation and space technology.
CASI
Dictionaries; Terminology; Aerospace Sciences; Astronautics; Aeronautics; Astronomy; Aerospace Engineering

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Report Documentation Page

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
NASA/SP—2000-7037/SUPPL413		

4. Title and Subtitle	5. Report Date
Aeronautical Engineering A Continuing Bibliography (Supplement 413)	March 2000
	6. Performing Organization Code

7. Author(s)	8. Performing Organization Report No.
	10. Work Unit No.
9. Performing Organization Name and Address	
NASA Scientific and Technical Information Program Office	11. Contract or Grant No.

12. Sponsoring Agency Name and Address	13. Type of Report and Period Covered
National Aeronautics and Space Administration Langley Research Center Hampton, VA 23681	Special Publication
	14. Sponsoring Agency Code

15. Supplementary Notes

16. Abstract

This report lists reports, articles and other documents recently announced in the NASA STI Database.

17. Key Words (Suggested by Author(s))	18. Distribution Statement
Aeronautical Engineering Aeronautics Bibliographies	Unclassified – Unlimited Subject Category – 01

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified	124	

For sale by the NASA Center for AeroSpace Information, 7121 Standard Drive, Hanover, MD 21076-1320